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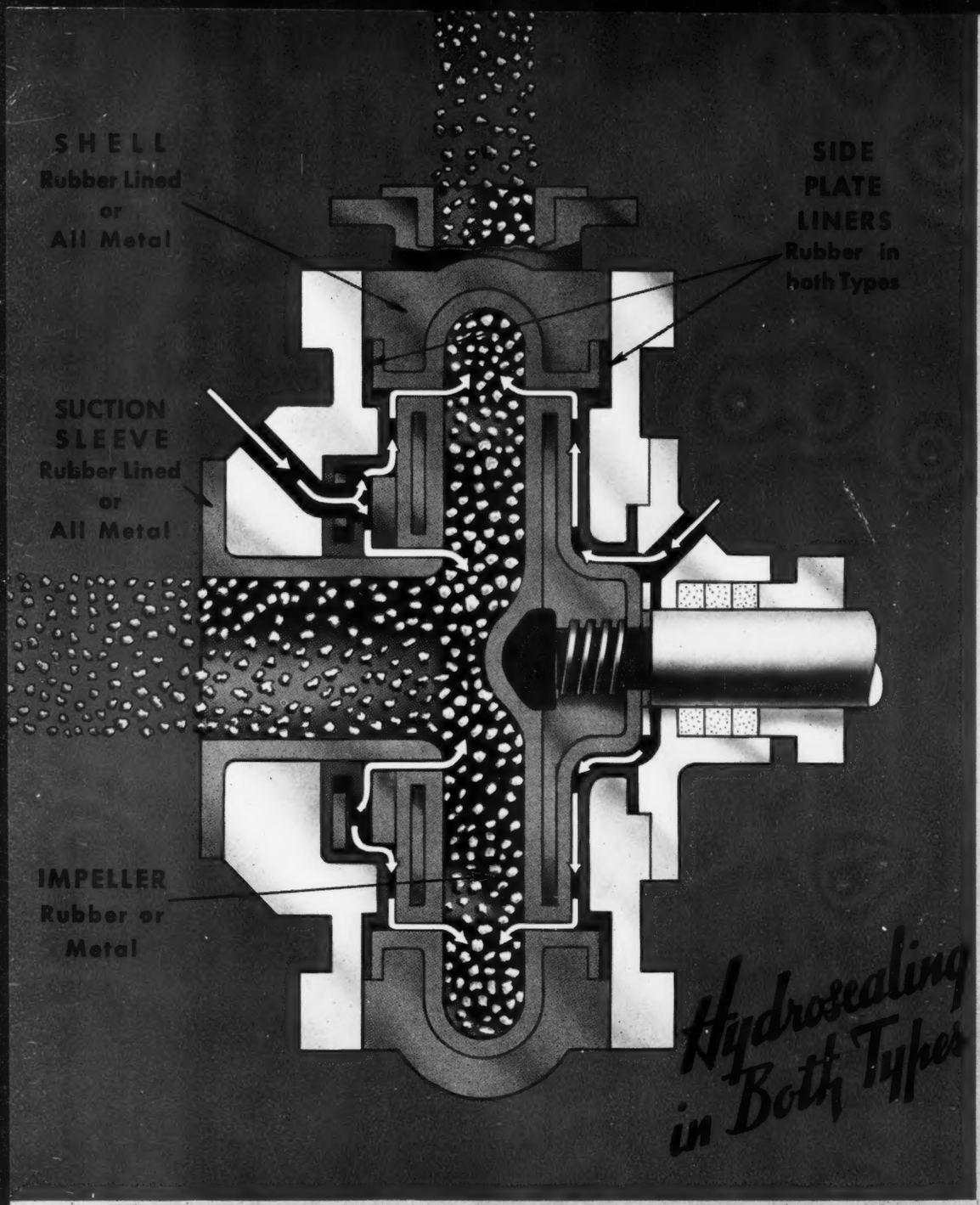

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No More Depression. The subtle wit of lead miners in Ozark foothills might prove to be a fertile field for gag writers. The story about "Prosperity Around the Corner" is eclipsed by a miner who said he was convinced the depression was over because he saw a rabbit cross the road and nobody was chasing it.

▼

Snake Eyes. Mining men that gather weekly (more or less) around the festive gaming table might like to learn that after you've lost your shirt, do as some "experts" in the South do—throw dice for social security cards, and you may be a rich man in your old age.

▼

All This Talk About Gold has sent not only gold producers but business and industry in general seeking enlightenment concerning facts about the problem. We suggest you relax and turn to page 292 in this issue and read carefully the article "Gold Rumors," by H. N. Lawrie, consulting economist.

▼

Ore Bins are being built or rehabilitated at many small mining properties. The procedure of designing small wooden ore bins, step by step, will be the subject of an article by W. W. Staley in an early issue.

▼

It's In Yugoslavia, in case you want to go. Reports of a gold strike in Alaska, Canada, or Russia are common, but now Yugoslavia seeks its place in the sun, a report being that lawyers, priests, policemen, undertakers, shopkeepers, and many others have scrambled for ground in the Lashve Valley, where placer gold in paying quantities has recently been found.

▼

Fluorspar is in demand, and the nation's major deposits in Illinois and Kentucky are now striving to make up lost production due to the heavy floods in January and February which forced a suspension of operations for almost six weeks. An article describing present conditions in the district together with milling practice will appear in an early issue.

▼

Big Diggings. The auriferous belt of Western Australia occupies approximately 256,000,000 acres. It is nearly eight times the size of England and Wales combined. Transportation is the major problem; but the huge reservoir of gold potentially available may in the years ahead become an important reserve. Though discoveries are slow in reaching a productive stage, the ingenuity of prospector and miner may be depended on, as always, when and as the world comes to need the hidden wealth of the vast and virgin field.

▼

Page Emily Post. A story from Alaska advises that at a mine in the vicinity of Ketchikan, the problem of proper dress for meals has been solved. The cook is a lady of culinary skill and good looks, and miners that come for their noon meal change their clothes, eat their lunch (midst roving glances), then hurry to change into their working clothes again and rush back to work. Even the grizzled blacksmith remarked he would do anything to please the fair cook.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

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WILLARD CHEVALIER
Vice-President

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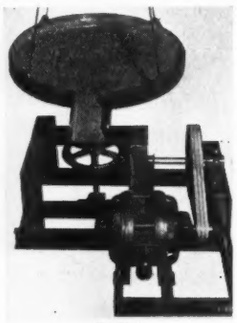

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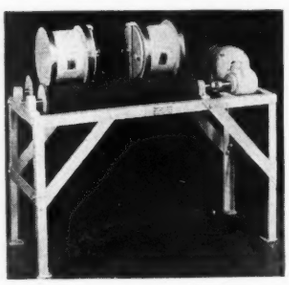

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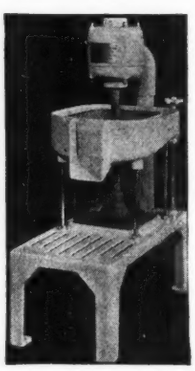

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JUNE 1937

The South Looks Up

TIME WAS when the state of business and the well-being of the people of the South hinged largely on the price of cotton. With that unsatisfactory, the farmer was hit, merchants were less ready to stock up, manufacturers took heed, and a general slackening occurred all along the line, with the result that the ultimate consumer—the mass of the people—speedily had less to spend and the vicious circle went its depressing round. That was so even before the days of the well-known, still lingering, big depression, of which the Southland has had its share, and it always will be so in any area that depends largely on the production of one commodity for its living. But cotton, though still royal, is no longer King in the South. The Southern farmer is learning to diversify his crops, textile manufacture has had a phenomenal growth, other new industries are taking root, and a more normal existence is breeding a more stable prosperity. And a jester might add, the South is not so hot either, with air cooling gaining acceptance rapidly in many quarters.

Improvement is to be noted also in the mining industries of the South. Here one finds no restriction to a single commodity. A diversity of non-metallics, widely scattered over several States, provides one of the most interesting aspects of mining there, phosphate rock, sulphur, marble, feldspar, kaolin, and mica predominating. And in the processing of these non-metallics a better technology is gaining ground. The importance of producing uniform grades that will also meet specifications is winning recognition, and no producer has to be told of the value of higher recoveries.

The most fascinating aspect of mining in the South is to be found in the incomparable Birmingham district—a steel-maker's dream it has been called—unequaled elsewhere on earth, with its ore mines, coal and limestone sources, all compactly assembled by Nature as if for the specific purpose of making iron and steel on the spot, and with furnaces and fabricating plants, auxiliary industries and railroad network, and the necessary labor supply, all in a limited, quickly traversed area. Birmingham is active; its ore output for the current year will probably more than double that of 1934. Here also in the ore mining activities is to be noted increasing recognition of what the situation today requires. Take it all in all, the South is looking up, as it never has before. Some stimulus it may have had and be still enjoying from New Deal measures, but even without these it is unquestionably on its way to a hitherto unseen development.

Toward a Mineral Policy

THE PROPOSAL that Brookings Institution make a thorough study of economic problems affecting the mining and the mineral industries is most welcome. No other agency is in a better position to correlate the factual matter gathered by governmental agencies, and make a sound interpretation that will command the respect of policy-forming officials in Washington.

One of the constructive efforts of the New Deal with reference to mining was the appointment of a Planning Committee for Mineral Policy. That committee made a splendid start in formulating a statement of problems. It presented a preliminary report which raised the hopes of mineral economists. Unfortunately, it did not prove feasible for the committee to continue this work, and the promised final report was never prepared.

The task which that earlier committee laid down should again be taken up. Unfortunately, however, the government bureaus which have to do with fact gathering, like United States Geological Survey and the Bureau of Mines, are not in position to handle such a policy-formulating job. In fact, it would probably weaken the

fact gathering of these bureaus were they compelled to undertake the added *policy* studies. The industries will, therefore, welcome the suggestion that Brookings Institution undertake this difficult, but extremely important, task. All will hope that nothing will interfere with the early prosecution of the study under its auspices.

Control of Silica Dust

RULES PROMULGATED by the Industrial Board for the control of silica dust in rock drilling in the State of New York became effective May 1. Although there is relatively little metal mining in New York, compared with the quarrying of non-metallic minerals, it is quite possible that action taken by this State to control silica dust in rock drilling for the prevention of silicosis may influence legislation elsewhere.

This is particularly true in view of the careful and painstaking investigations made by the New York authorities. The all-inclusive occupational disease legislation relative to silicosis was passed in 1935, but it was soon found unworkable, particularly with respect to compensation insurance. So the law was materially amended in 1936, and the Industrial Board began a series of studies, industry by industry, to determine the prevalence of silica dust in mines, quarries, foundries, and maunfacturing plants. In formulating its code for rock drilling the board had the benefit of studies by an advisory committee composed of representatives of employers and employees, medical and engineering experts, and manufacturers of dust-control devices. Thus all who were to be affected by the regulations had a voice in their formulation.

Conditions in New York have led to the division of silica-bearing rock into two classifications—those containing (a) 10 per cent or more by weight, or a variable and unpredictable content free of silicon dioxide, and (b) uniformly less than 10 per cent by weight of free silicon dioxide. Broadly speaking, rocks accompanying metalliferous ore deposits fall in the first class, and non-metallic mineral deposits in the second. Injurious silica dust concentration arising from rock drilling is defined as more than ten million particles per cubic foot of air, with respect to the first class, and more than one hundred million for the second, as determined by an approved dust-count method. Dust-control devices, including wet drilling, are subject to test and ultimate approval by the Industrial Board.

Other States may well follow the reasonable example of New York in its attack on the silicosis problem. No hasty action has been taken that would impose harsh restrictions on operators. Time has been allowed for study, tests, and public hearings before regulations have been adopted. On the whole the procedure has been well considered and the results are likely to prove satisfactory.

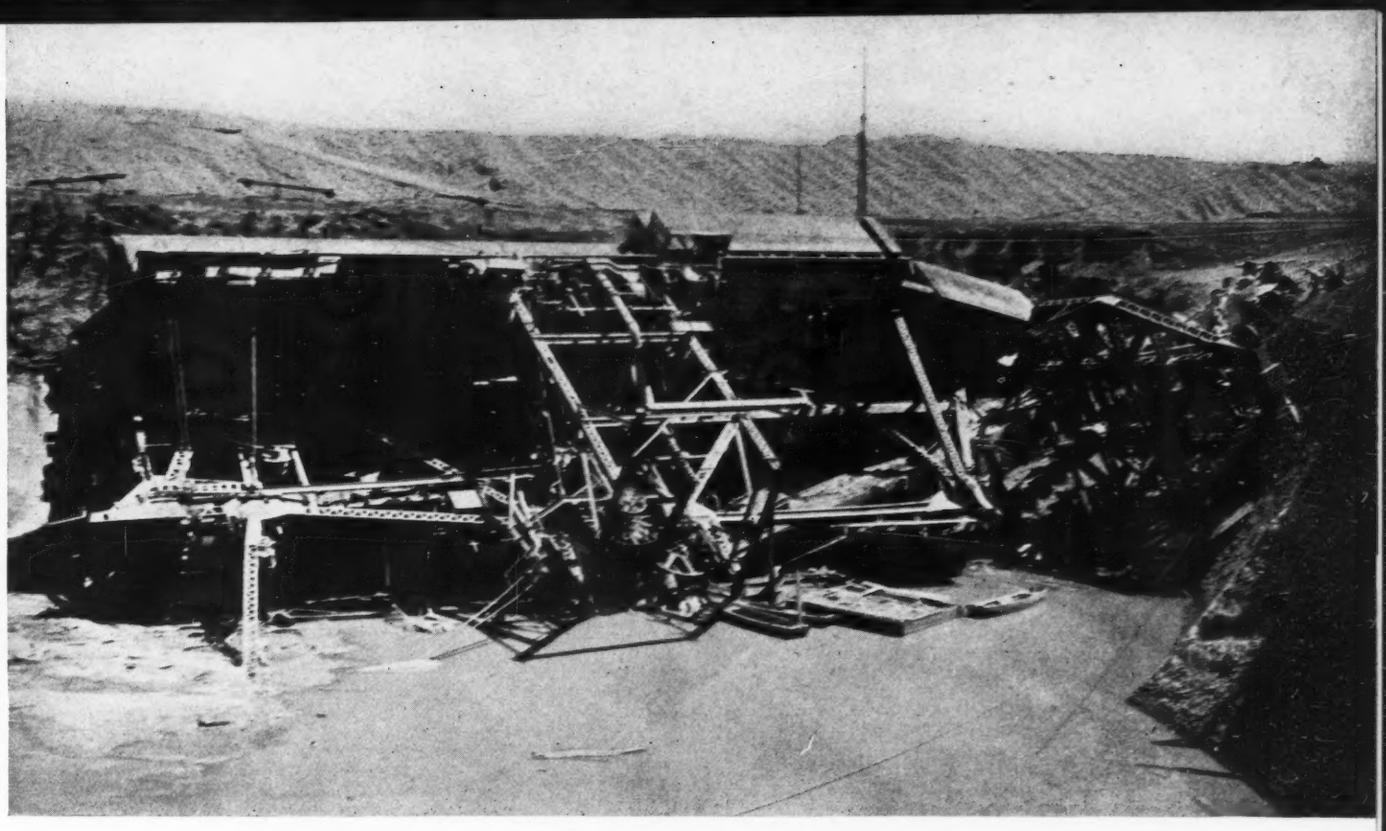
Incidentally, it is worth emphasizing again that the metal-mining industry must take all reasonable steps to avert the menace of silicosis if it is to escape intolerable penalties for carelessness. Cost experience on the Rand is significant. A recent report of the Miners Phthisis Board shows that payment of benefits to miners for silicosis and tuberculosis from August, 1925, to April, 1936, was of the order of $42,000,000. Levies on 38 mines for the financial year 1935-36 were approximately $4,000,000. Silica dust control may add to the cost of mining in the United States, but failure to abate the hazard is likely to be more expensive.

Blasting Caps for Children

NOBODY would recommend blasting caps as playthings for children. But apparently careless adults leave these extremely dangerous articles lying around where children can't help finding them. Natural curiosity results in their detonation by one means or another, with resulting injury and sometimes death. In 1936 over 200 children sustained injuries by playing with blasting caps. Eyes were blinded, fingers were torn off, and little bodies were otherwise mutilated. For the past decade the yearly average of children thus injured is over 250.

These and other facts are publicized by the Institute of Makers of Explosives, which, since 1926, has conducted a vigorous campaign against this hazard. The geographical distribution of these accidents shows a concentration in mining areas. Children find the caps on the highway, in unguarded sheds, and even around miners' homes. Just to see what will happen, they throw the caps into a fire, light them with a match, pick them with a pin, knife or nail, and sometimes hit them with a hammer.

A heavy responsibility rests upon miners to see that blasting caps are not carelessly discarded where children can find them. Statistics show a sharp rise of these accidents in the summer months. So now is the time to cooperate heartily in a safety movement to eliminate this needless peril to children.



1 THE DREDGE resting on its starboard side as it appeared after the pond had been pumped dry. The bow gantry is still held to the deck by its port footings. Stern gantry and superstructure are partly buried in the mud. Part of the housing and equipment has been removed. A leak in the hull overturned the dredge in 60 ft. of water.

When a Gold Dredge Capsizes

How the Natomas Company Righted and Dismantled a Sunken Boat

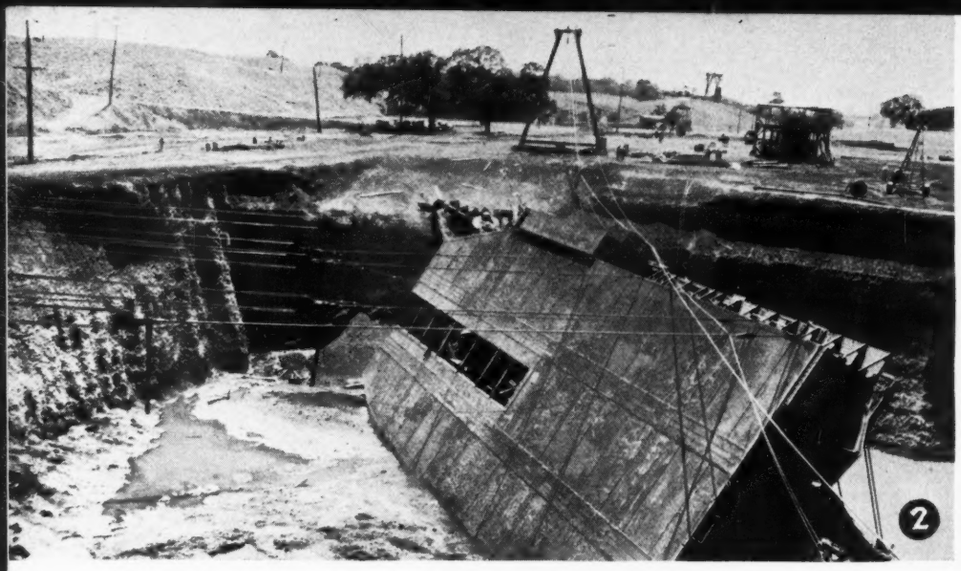
Cyril Thomas
Natomas Company
Natoma, Calif.

RIGHTING and then dismantling an overturned gold placer dredge was an unusual engineering undertaking recently completed by the Natomas Company in its operations near Folsom, Calif. The dredge, known as Natoma No. 8, was of all-steel construction with the exception of the deck, which was made up of 4x6-in. timbers bolted to the deck beams and caulked for water-tightness. Its hull was 10 ft. 6 in. deep, 56 ft. wide, and 150 ft. long, and, under operating conditions, had a total displacement of about 2,200 tons. The dredge was capable of digging 70 ft. below the surface of the ground and could handle 600 cu.yd. of material per hour. It had been in continuous operation since 1913. The buckets on the digging ladder were of 17½-cu. ft. capacity.

On the evening of April 29, 1936, the hull developed a leak, and before any remedial measures could be taken it overturned on its side in 60 ft. of water. This occurred so quickly that members of the crew barely had time to disembark.

To determine the damage done, pumps were installed on barges and the level of the pond was lowered. Exposure of the hull disclosed that the water had entered through a hole in the well end-plates below the water line, caused by wear from the save-all gravel deflected by the bucket idler.

The dredge was resting on its starboard side, with the bottom of the hull up and at an angle of 32 deg. with the vertical (photographs 1 and 2). Both the upper part of the stern gantry and the superstructure were partly buried in the mud. The upper end of the stacker was resting on the sand at the stern, and the lower end, on the deck, was badly buckled and twisted. Also, the bow gantry had been pulled away from the starboard footings, but the port ones were holding the gantry to the deck, although the outboard leg was buckled near the



2 BOTTOM UP and 32 deg. to the vertical, the dredge is seen from its stern, after the pull lines have been attached. In the distance are the portable "A" frame and winch used in righting the boat

3 THE PULL LINES used to right the hull. Five sets of them were attached at as many points. It was estimated that a pull of 1,250 tons would be sufficient, after first removing about 800 tons of equipment

4 JUST BEFORE RIGHTING. All pull lines are slack except one set. The greatest pull came not at the start but after dredge had been raised about 18 in. Each set of lines pulled about 300 tons

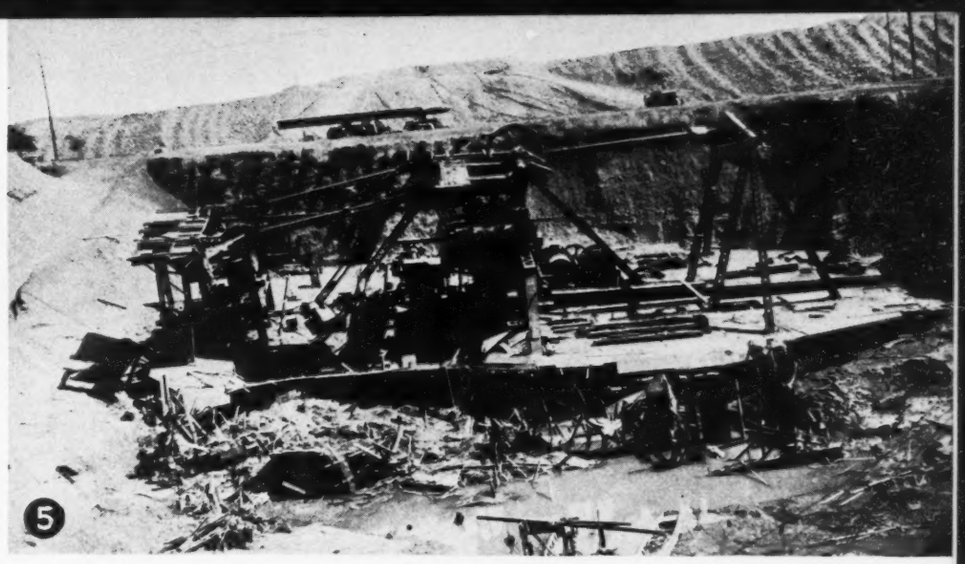
footing. The top of the gantry was resting on the bank at the face of the cut (photograph 1). The lower tumbler was 12 ft. below the ground prior to the accident, and it remained at this elevation after the dredge turned over. Examination of the bucket ladder showed two points of failure: one near the upper tumbler and the other at the mid-point. The forward part of the superstructure was buckled and twisted. The bottom plates on the hull near the stern were buckled, and a large area of wood decking and steel deck beams on the starboard side between the upper tumbler and the stern was completely crushed (photograph 5).

After the pond was drained, it was noted that, from the upper tumbler aft, the hull was resting on sand, whereas that part forward appeared to lie on mud and slickens and to be supported by the bucket ladder. This position of the hull indicated that an excess weight was being supported at the stern, which caused the failure of the decking and the deck beams, and the buckling of the bottom plating on the hull.

The extent of the damage, together with the pitting and corrosion of the hull plating during the years in service, precluded any plans to right and repair the dredge for further service. It remained, therefore, to dismantle salvageable parts and machinery that could be used as spare units on the other dredges in the division.

The location of the dredge in relation to roads, tailings, and high-tension power lines and its recumbent position were the deciding factors in determining the safest and most feasible plan of procedure. A system of lines was rigged up to hold the dredge in position while all available machinery and parts were cut loose and removed with a trolley suspended on a high line. The dredge was then pulled back to its normal position with the pull lines and the dismantling completed. It was necessary that the first pull lines cross the country road, which paralleled and was adjacent to the dredge cut. Permission was granted to close a portion of the road, and a 1,500-ft. detour was constructed over the tailing piles on the opposite side of the road. Signs and flares were installed at each end, and the detour was properly marked to guide and safeguard the traffic.

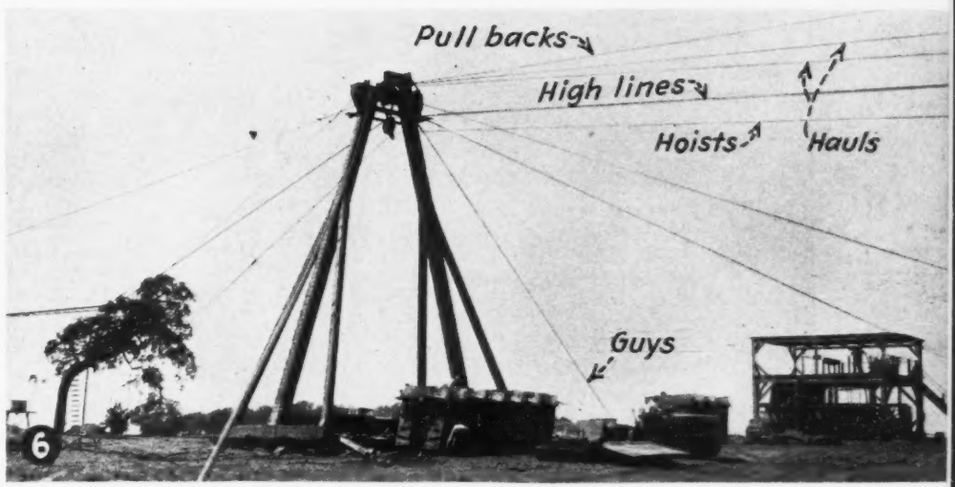
It was estimated that 800 tons of equipment could be removed before the dredge would be pulled over, and that a pull of 1,250 tons would right it. To transmit the pull, five sets of lines were used. Five points on the superstructure were selected, and to each was fastened one sets of lines. Each set consisted of a 2¾-in. wire rope with one end fastened at the dredge superstructure and the other end carried up and over the hull (see bow-end view of photograph 2) to one

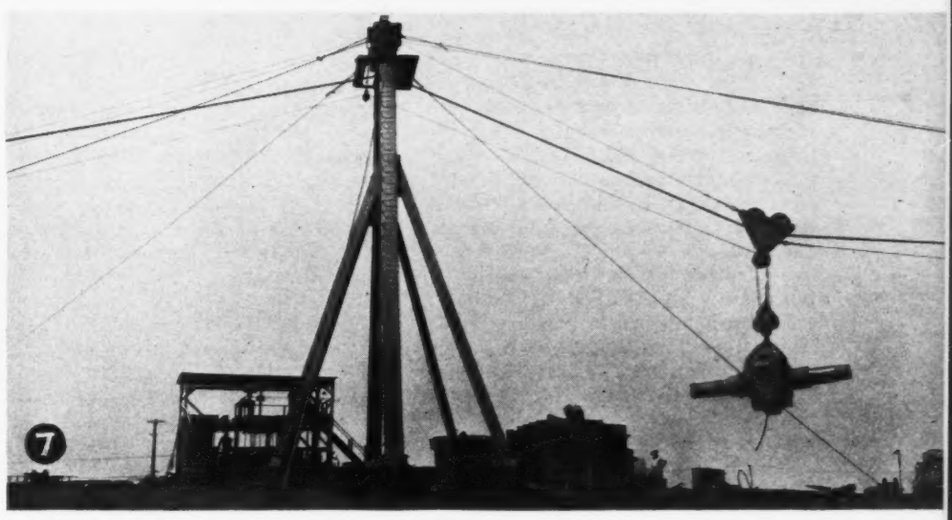


5 RIGHTED AT LAST and partly dismantled. Part of the house and some of the tables remain in the mud. The decking is seen to be crushed on the near side

6 FORTY-FOOT "A" FRAME and, at the right, the ten-drum side-line winch which operated the pull lines. The haul, pull-back, and hoisting lines for the trolley are carried over the frame on sheaves

7 AFTER THE DREDGE had righted itself the screen, superstructure, upper tumbler and other machinery were removed. The trolley is carrying the upper tumbler and shaft weighing 20 tons. The size of the tumbler can be compared with that of the man standing in the picture





set of blocks on an eight-part tackle of 1⅛-in. lines. The other set of blocks was situated on the road and dead-ended with four 1½-in. lines to a 30-ton spud buried in the tailing pile. The pull line for this tackle was carried around a deflecting sheave, which was dead-ended with one 1½-in. line to an 18x18-in. timber buried in the ground, to one set of blocks on a four-part line of ¾-in. rope. The other set of blocks was situated about 460 ft. west, and dead-ended with one 1½-in. line to a 35-ton spud placed in an excavated trench. The pull line for this tackle was carried around a deflecting sheave, dead-ended to the same spud, and then to the winch. Total take-up on each set of lines at the winch was about 1,600 ft.

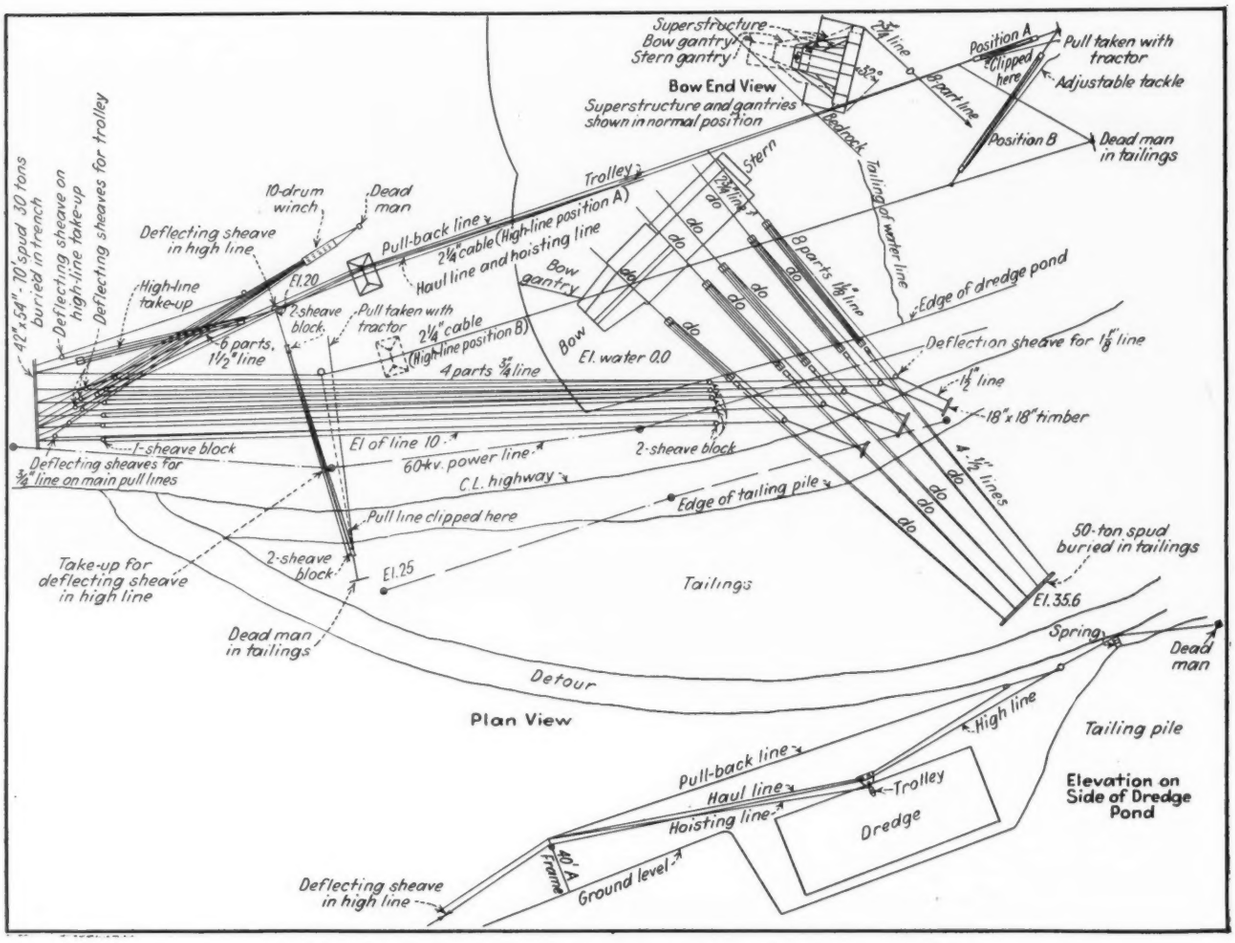
The winch used was a ten-drum unit, commonly known in dredge practice as a side-line winch. It was driven by a 75-hp. motor, and the drums were controlled by hand-operated levers placed on a platform directly over the winch. From this position, the operator could see all the lines and operations.

To facilitate dismantling, it was essential that the high line be moved to various positions both before and after the righting of the dredge. This was made possible by fastening one end of the 600-ft. high line to an adjustable tackle (see the drawing), the other end being carried over the dredge pond, through a hanging sheave on the "A" frame, around an adjustable deflecting sheave, and then fastened to one set of blocks of a six-part tackle of 1½-in. lines. The other set of blocks of this tackle was dead-ended to the 35-ton spud, and the pull line carried to the winch. Then the high line could be raised or lowered from the winch. The adjustable deflecting sheave assured a fair lead for the high line as it passed through the "A" frame. Both trolley and high line were designed for a 40-ton load.

The movable "A" frame was 40 ft. high and consisted of two pieces of 18x18-in. timbers for supports with an 18x18-in. cap resting on a steel bearing plate. Side braces were made from 10x10-in. timbers. The frame was constructed on two 18x18-in. timbers which were used as skids. The haul, pull-back, and hoisting lines for the trolley were carried over the "A" frame on sheaves, and then by means of deflecting sheaves to the winch.

With the adjustable tackle at one end, the movable "A" frame and the deflecting sheave in the high line, the operations of dismantling and moving of the high line were satisfactory. Care was taken in placing all the dead men to assure a firm bearing against the soil or tailings. All dead-end lines were carefully arranged and adjusted so that each carried an equal part of the total pull.

After the five sets of main pull lines, the high line, and trolley had been installed, the preliminary dismantling started. This was hazardous



DISMANTLING AND WRECKING tackle, as arranged for righting the sunken dredge, is illustrated in this diagram

and dangerous work, as mud and slickens had accumulated over the entire structure. Because of the resting position, the machinery was suspended from the deck—in this case above the workmen. However, from the start to the finish of the job there were only two minor accidents. In each case, the workman was absent only a few days.

Exposed parts of the housing, gold-saving tables, spud, stacker, bow and stern gantries, buckets, available machinery, and the digging ladder were removed. The digging ladder was cut up and moved in sections. An auxiliary tackle was rigged up to support that part of the ladder remaining on the dredge as the dismantling proceeded. Contrary to first assumptions, the bow of the dredge did not dip when the first section of the ladder was removed, thus proving that the weight of the hull forward was not supported by the ladder.

Preliminary to the righting of the hull, all mud and slickens were washed off the superstructure and the hull. An attempt to remove sand banked against the hull at the stern by means of a bulldozer was only partially successful, due to lack of support for the machine in the material handled. The pond was filled with water to a depth of 25 ft. to cushion the shock to the hull and also to prevent the bow from hitting the side of the bank with too great a force when it was pulled over. Due to variables in the pull lines, necessitating variable speeds if all lines were to be pulled together, a short pull was taken on each line in consecutive order. The distance each line was pulled was governed by the load on the winch motor and the appearance of the other lines.

As the dredge righted itself and the pull decreased, the take-up on the lines increased. The greatest pull did not occur at the start, as was expected, but after the dredge had been pulled up about 18 in. At this point, the pull increased considerably, due to the housing and the gold-saving tables on the starboard side being buried in the mud. These parts were pulled loose from the superstructure and hull, the rivets either shearing off or being pulled through the plates. Although no actual measurements were taken at the time of the maximum pull, from observed action of the motor and appearance of the tackle, and an examination afterwards made of the lines, sheaves, and sheave pins, it was estimated that each set of lines was pulling approximately 300 tons.

As the righting proceeded and the pull decreased, the pull lines were reduced from five to four to three and finally to a single line. Photograph 4 shows the dredge just before it righted itself. The final dismantling and removal of the screen, superstructure, upper tumbler, and remaining machinery was then completed. The hull was left in the pit, as the salvage value did not warrant dismantling it.

The job was completed on Sept. 10, 1936. About 30,000 ft. of wire rope from ¾ in. to 2¾ in. in diameter was used, and a crew of 60 men was employed during dismantling and salvage operations. All work described was carried out under the direction of R. G. Smith, manager of the Natomas Company's gold-dredging department.

SCRAPERS REMOVE ore left in the floor between pillars at the Bonne Terre mine. The haul shown here is almost 300 ft., the scraper loading 2½-ton cars that pass below the platform

More Lead From Southeast Missouri

Scrapers Now Supplement St. Joe Shovels in Removing 20,000 Tons of Ore Daily

H. C. Chellson
Assistant Editor

SETTING a faster pace in production because of improved conditions in the lead market, the mines of the St. Joseph Lead Company, 60 miles south of St. Louis, Mo., are now producing at near capacity—20,000 tons of lead ore per day—compared with only 10,000 tons two years ago.

The mines lie in a mineralized district approximately 120 miles square at an elevation about 800 ft. and the deepest workings reach 500 ft. Underground, there are extensive machine shops and about 85 electric locomotives that haul ore through 125 miles of flat underground workings. Operations have been stepped up gradually since the depression, work being staggered, thereby assuring a maximum number of men on the payroll. On Oct. 1, 1936, operations were on a six-day basis every other week and on Nov. 15 the schedule was seven days a week every other week. On March 1, 1937, the five-day week four weeks a month started, the mine producing on a two-shift basis and the mill operating three shifts. On Dec. 1, 1936, wages were resumed on the 1929 scale.

During times of low and high metal prices for lead the company has always maintained a policy of close cooperation with its employees. This attitude has created a feeling of trust and confidence in the company by the miners and has promoted efficiency throughout the numerous departments of the organization.

Operations are divided into two divisions. The main office is at Bonne Terre, headquarters of the general manager. Each division has a general superintendent, under whom are the mine superintendents and assistants of each respective unit. The northern group of units includes Bonne Terre, Leadwood, and Desloge. Ore is hoisted in skips through vertical shafts at these mines and dumped directly into the respective mill bins. Bonne Terre, Leadwood, and Desloge divisions have a combined capacity of 10,000 tons per operating day of 24 hours. The southern group, called the Federal Division, produces from seven different areas, all ore being electrically hauled to rotary dumps and hoisted through No. 17 shaft and dumped directly into the Federal mill bins. Total production from these seven areas at present is 10,000 tons of ore per day. All the mines of the north and south divisions have underground connections except Bonne Terre, as that lies farthest north. Mine La Motte, about 30 miles south of Bonne Terra, closed in 1931, is being prepared for operation if the lead market should improve in the near future.

Many improvements in operation resulting from study and promotion of helpful ideas from the men came as an asset from the depression. Some of these were generally described in 1935, July issue of *Engineering and Mining Journal*. The purpose of this article is to mention some new developments, since that time.

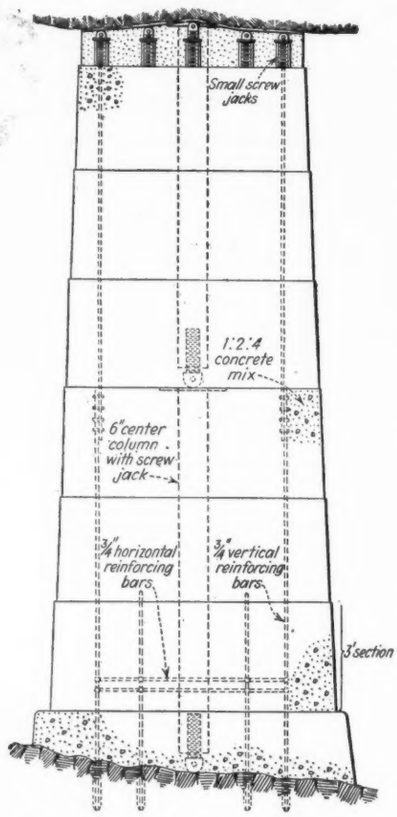
In November, 1936, scraping operations employing double-drum hoists were introduced for the first time in the Lead Belt. This practice was carefully studied on visits by operating executives to mines employing it, and

a large model was also made showing how the method could be successfully employed under their system of mining. Equipment for this purpose has been standardized, employing 35-hp. double-drum hoists and 54-in. scrapers. At present four scraper units are used respectively in the Bonne Terre mine, at Desloge, and at Leadwood. Equipment is being added at the rate of three scraper units a month until a total of twenty are installed among the various units as necessary. These scrapers are being installed to supplement the St. Joe shovels commonly used in the district. In some areas in the north division, especially at Bonne Terre, the ore pillars contain a higher than average grade of lead. Such pillars were left many years ago, and their diameter being unsually large, they can be easily reduced by jackhammers without disturbing the beam strength of the roof. Thousands of tons of ore can thereby be recovered in the old flat stopes by using the scraper method to load cars instead of purchasing more St. Joe shovels, which are more expensive. In some places rich pillars rest on a floor of commercial ore having a depth of 6 to 12 ft. In addition to slicing the pillars, the floor between the pillars (this 6 to 12 ft.) is removed by benching and the broken ore is removed by the scraper method, being either pulled up a ramp and loaded into cars, or pulled into chutes, depending on the conditions underground. Portable slides are provided for use if there be interference to slushing by pillars.

In other parts of this district, such as in the Leadwood area, the ore contains several rich seams, and many pillars of such high-grade ore had to be left in stopes to support the back. The pillars have a large diameter, are close together, and contain a substantial tonnage of high-grade ore. Preparations are being made to remove many of these pillars by the construction of concrete pillars. This method has proved successful, so far, as it has relieved pressure on many old pillars, helped support the back, and permitted the removal of old pillars without difficulty. In areas where there is more than one level the mine surveyor carefully checks pillar locations so as to place concrete pillars directly below each other.

Before installation of a concrete pillar, several factors are considered: the most effective location to support the back, which should give the minimum hindrance to scraper operations or ore removal by St. Joe shovels; the base of the concrete pillar should rest on solid bottom, be it ore or limestone, and it should be directly above the pillar on the level below. The bottom of the concrete pillar is given a diameter that will permit a slight tapering, so that when it reaches the back it will have a minimum diameter of 8 ft.

At first pillars were started directly from the floor, but it was later found better practice to first construct a concrete base of sufficient width, allowing a shoulder of about a foot around the pillar bottom. The average height of this base is about 24 in. When the site is cleared for the base, sixteen holes are drilled, each 2 ft. deep and 18 in. apart, each hole located on a radius 3 ft. 8 in. from the center. In these holes are grouted ¾-in. diameter vertical reinforcing steel rods 9 or 12 ft. high. In the center of the base is set a 6-in. diameter pipe column, having a screw jack attached that rests on the floor. The purpose of the screw jack is to elevate and set the column high enough so that the steel plate resting on top of the column will extend slightly above 9 or 12 ft. as each pouring of concrete takes a form 3 ft. high.



Sketch of concrete column about 22 ft. high that supports the roof so that ore pillars can be removed

The center column is held plumb by wires fastened to the vertical reinforcement bars. To bind the vertical bars, ¾-in. bars are bent in circular fashion by a bending machine and wired to the vertical bars. These bars are placed horizontally about 5 in. apart. To maintain the circular shape of the pillar a 10-gage iron form, 3 ft. high, is placed around the wire structure and concrete is then poured. A 1-2-4 mix, in an electrically driven mixer, dumps directly into an arrangement which shoots or blows the concrete through a 4-in. pipe directly to the form to be filled. The mixing and blowing units are conveniently located so that several pillars may be made from one set-up, but the equipment is portable and can be easily moved, as it rests on mine car trucks. After a 3-ft. section is filled with concrete, it sets, and later the form is removed and moved into the next 3-ft. position. In this manner the pillar is built up to the top of the center column.

Continuing the pillar upward, more vertical bars and horizontal reinforcing bar are placed (see sketch) and another 6-in. central column is plumbed directly above the first. Filling with concrete and consequent setting continues in 3-ft. sections until the pillar reaches within about a foot from the top of the roof. At this point numerous 3-in. diameter pipe screw jacks are placed on top of the pillar. They are spaced about 18 in. and on top of each pair of jacks is placed a piece of ½-in. iron plate. The jacks are screwed up, pressing these plates against the roof as tight as possible. After all the jacks are tight, this last space is ready to be filled with concrete. Pieces of scrap iron are thrown on top of the pillar and the space is filled with cement that buries the jacks. The highest pillar so far built in this fashion in the district is 47 ft., but pillars as high as 60 ft. are being considered. Most of the concrete pillars are found in the Leadwood mine, but some have been built at the Bonne Terre and Desloge mines. At Bonne Terre the ore extends to a considerable height, and pillars must be carefully placed one above the other on each respective level.

The extensive flat-lying replacement deposits in limestone permit a flexible program in underground transport that covers 125 miles of underground track, electric signal systems, hundreds of miles of wiring, and many electric locomotives. At the Federal Division the haulage system has been extended, and 70-lb. rails are now used throughout the main haulage drifts. A new 25-ton electric locomotive has been ordered for the 24-in. gage track. This will permit moving 45 cars, each containing 2½ tons of ore per trip, between No. 17 and 12 shafts, involving a 1¼-mile haul on a 1.8 per cent grade against the load. Twenty-one 15-ton electric locomotives are in service at this divsion, and some smaller ones will be added so as to eliminate the use of mules for gathering cars from the St. Joe shovels to the main-line track. The facilities of the underground machine shops, electrical shop, and supplies at the warehouses at Federal have been increased so that practically all mechanical operations devoted to the mine are performed underground. The object of this was to assure more time for hoisting ore in

LEAD BULLION stored in the smelter yard at Herculaneum.

EARLY MORNING MOVIES — in underground "theaters" — are shown at all mine units. A program maintained by the Safety Department shows comedies as well as films promoting mine safety

the event production should be increased above 10,000 tons per day.

A system of sampling ore from the seven different areas of operation at this division is now practiced. This gives mine operators a better control on mining. A small sampling office has been set up near the two rotary dumpers at Federal and three small chute bins attached to the sides of the rotary dumper catch pieces of ore from each car as it is dumped. The sample is collected in pails after each trainload is emptied, is marked, and thrown into a small jaw crusher, then pulverized, coned, and quartered, and sent to the assay office. Daily assay reports issued to the mine foreman inform him of the grade of ore his section is mining, and he directs his work accordingly to lower or increase the grade of ore so as to maintain an average between 3½ and 4 per cent lead. This is quite possible, as the ore formation consists of disseminated ore in the upper levels and the levels nearest the sandstone have rich solid streaks. The ore has a slight greenish tinge which is a characteristic of the glauconite commonly found in some areas. The average copper content of the ore is less than 0.15 per cent, and zinc content is also very small.

Some ore has been found in drill holes in the sandy limestone, but no ore has been found in the pure white sandstone underlying the limestone. Diamond-drill holes have bottomed in igneous rock in the district which occurs in hills and granite knolls under the sandstone.

Next to mine-haulage, pumping water is most expensive. In August last year the drought dried up the Big River except for a few tiny streamlets accidentally found running into a wide crevasse in the limestone. This crevasse was cleaned out and a 2-in. pipe was driven in the opening and the crevasse filled with concrete. Slimes from the Leadwood mill were sent through pipes and poured into the cavity through the 2-in. pipe. This practice has been followed for some time and some of the ground watercourses are believed to have been filled by this method. Slime poured into the ground through drill holes would often eventually find its way to the surface several hundred feet away. The Schultz farm is spotted in several places with gray slimes that have come to the surface, making a marked contrast against the green field.

When a hole is full and refuses to take more slime even under pressure, pipe connections are removed and the hole is left undisturbed for a few months. The holes are connected after this rest period and found to take slime without pressure. The explanation for this is believed to be the slow action of the ground water dissolving the limestone along the old watercourses, or the slimes slowly moving into other openings in the limestone.

About 400 tons of slimes are pumped daily into surface drill holes in the Leadwood area. During the past year a marked cut has been noted in the Leadwood pumping costs which are credited to this practice. The following figures are of interest: The flow in one pumping station before sliming was 1,775 g.p.m. and after sliming the flow was 1,330 g.p.m., this figure taken following heavy rains and rivers overflowing. Without sliming, this same area had a flow of 1,780 g.p.m. and during periods of heavy rainfall this flow increased to 2,470 g.p.m. A bulkhead with a steel door and one solid concrete bulkhead have been built during the past two years and it has been noted that in the western part of the Leadwood mine pumping has been reduced from 634 g.p.m. to 590 g.p.m.

In 1936, when the price of cadmium increased, the company started to recover the small amounts of zinc in the concentrates which were sent to the company smelter at Herculaneum. The cadmium in the zinc is collected in the baghouse, and every three months or so the flue dust is sent to a 6-ton cadmium plant near the smelter, when the cadmium is recovered and cast in small slabs.

About 400,000 lb. of lead concentrates are produced each day, from the four mills in the district, and the milling practice is fully described beginning on page 286. Most of the gravity concentrates and some flotation concentrate are sent to the smelter at Alton, Ill., and most of the flotation concentrates and some gravity concentrates are sent to the Herculaneum smelter.

THE BONNE TERRE MILL does not enjoy the benefits of gravity flow as do many Western mills that are built on the hillside. Ore is dumped into bins in the high shafthouse to the right and the three gable roof buildings joined together comprise the mill building

Milling Practice In the Lead Belt

Approximately 20,000 Tons of Lead Ore Is Being Crushed Daily

L. A. Delano
Mill Superintendent
Bonne Terre Mill, St. Joseph Lead Company, Bonne Terre, Missouri

▶ THE METHODS *and results covered in this description are of the Bonne Terre mill, but this practice is representative of all the mills in southeast Missouri of the St. Joseph Lead Company, with the exception of capacity of the plants and variations in general arrangement, size, and type of crushing units and other equipment. The present capacity of the active mills in this district per day of 24 hours is as follows:*

	Tons
Bonne Terre	2,600
Leadwood	4,800
Desloge	3,600
Federal	10,000
Total	21,000

ST. JOSEPH Lead Company began mining lead in 1864 in southeast Missouri at a locality later known as Bonne Terre. Between that date and 1883 a plant was developed to concentrate the ores. It was destroyed by fire in the latter year, and was replaced by the present building, which, with alterations and additions, is still in use. As a result of continued research, many changes have been made in equipment and practice, so that at present this plant is thoroughly modern in every respect. The capacity has been increased at times until it now treats 2,600 tons daily, and sometimes a rate of 2,800 tons is obtained.

The present practice has been developed to produce, by dry crushing with crushers and rolls, a product of approximately 94 per cent through a 14-mesh screen. This product is then deslimed, the sands are classified and tabled, and the slimes treated by flotation. The coarser sands from the rougher tables, with the middlings

THE FEDERAL MILL, largest of the four in the Lead Belt, is now treating about 10,000 tons of ore daily

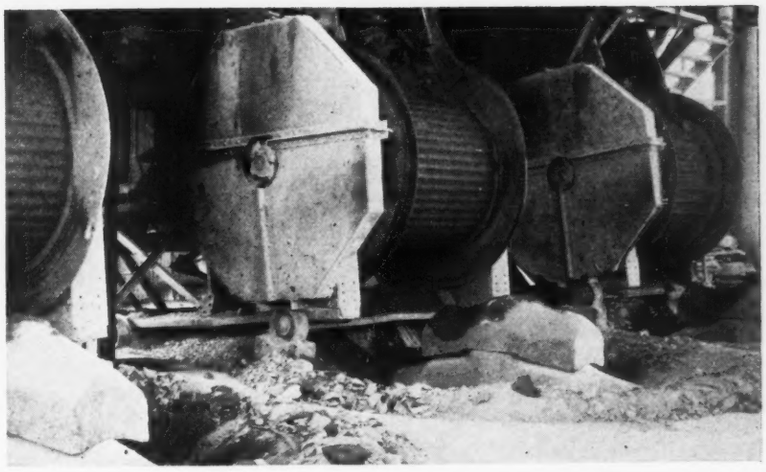
from the finishing tables, are reground by ball mills and returned in closed circuit with the original ore to the hydraulic deslimers, to be deslimed, reclassified, and re-treated. The fine product, obtained by dry crushing, has resulted in a smaller percentage of the ore to be reground by ball mills. Less colloidal lead is produced by dry grinding, enabling the plant to recover a larger proportion of lead in the gravity concentrate and resulting in a lower tailing loss by flotation.

Dry crushing is performed in three stages. In the first stage, a gyratory crusher breaks the ore to about 3 in. maximum. In the second stage, gyratory crushers reduce it to about 1 in. maximum, and in the third stage rolls finish it in closed circuit to pass 6-mesh screens. The run-of-mine ore is dumped from the skips, averaging $2\frac{3}{4}$ tons each, into a chute feeding the primary crusher. As no mechanical feeder is used, practically the full skipload enters the crusher at once, where it is crushed before the next skip is dumped. The crusher operator can signal the hoisting engineer to stop hoisting if the crusher is not cleared sufficiently for the next skipload. Forty to fifty skips are hoisted each hour, with a maximum of sixty skips in one hour. Table I shows operating data for primary crushing.

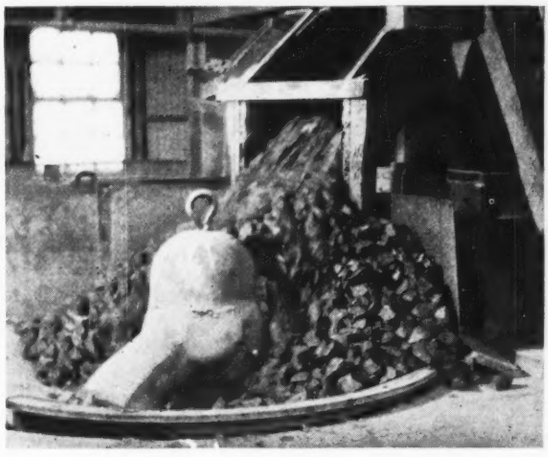
The concaves in the primary crusher are set on the eccentric center in order to produce a larger amount of fines, as the bulk of the ore is crushed on the side adjacent to the skip chute. Inner babbitt liners last approximately 100 operating days; the outer liners last about 50 per cent longer. The mantle and concaves of many manganese steels are maintained to proper size by electric welding, using hard-facing rods to resist wear.

The product from the primary crusher is discharged through a hopper onto No. 1 conveyor (data shown in Table III), which conveys it to the secondary crushing plant. A 36-in. lifting magnet is suspended over the head pulley to remove tramp iron from the ore. The conveyor discharges onto a 4x7-ft. double-deck vibrating screen set on an incline of 25 deg., driven at 860 r.p.m. by a 10-hp. motor, consuming 4.2 kw.-hr. A square woven screen cloth with 2x2-in. opening, $\frac{3}{8}$-in. diameter wire, 48 in. wide by 42 in. long, is used on the upper half only of the top deck and prevents the larger pieces in the ore from clogging the screen cloth on the lower deck, which has $1\frac{1}{4}$x$1\frac{1}{4}$-in. openings, $\frac{3}{16}$-in. diameter wire, and is 48 in. wide by 84 in. long. The screen cloth on the upper deck is bolted to a loose frame, which is clamped in the screen housing. The lower deck screen cloth is directly inserted in the housing and tightened by end tension bolts, with clamping bars on each side to retain the feed on the surface.

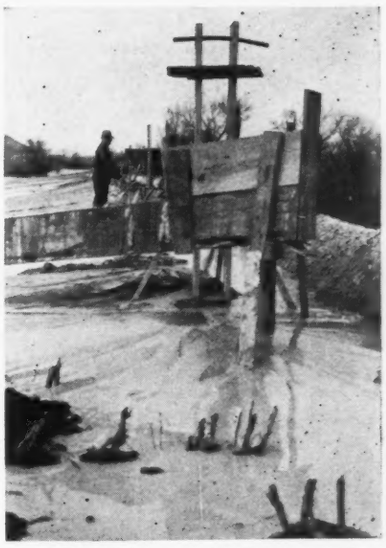
Oversize from the screen is re-crushed by secondary gyratory crushers. Four of these crushers are installed, two operating full time and one about 30 per cent of full time, to handle the tonnage; the fourth serves as a spare in case one is down. Table



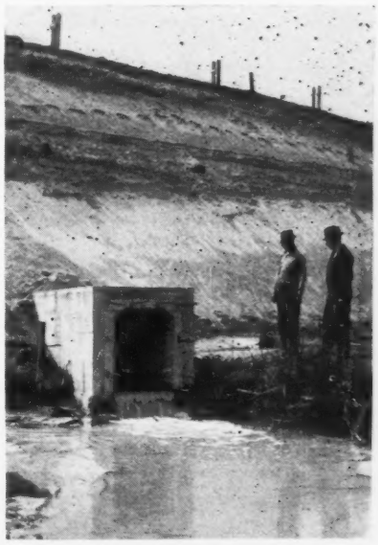
THREE DRUM FEEDERS, each making one revolution per minute, maintain constant feed to the gyratory primary crushers in the Federal mill



OVERSIZE from the first screening following the primary crushing drops into chutes feeding gyratory secondary crushers in the Bonne Terre mill



TAILINGS from the Bonne Terre mill flow 6,000 ft. through 8 in. pipe to this point on the new tailings dam adjoining the old chat pile to the rear, that was built up years ago by dumping from railroad cars



WATER in the tailings pond overflows into a vertical concrete shaft in the center of the pond and flows out clear in the drainage tunnel through the dam

Table I—Primary Crushing Data

Type of crusher	Gyratory
Concave opening	
Top, in.	18
Bottom, in.	1⅞x2⅜
Gear ratio	5 1/17
Pinion, r.p.m.	348
Eccentric, ditto	116
Tons crushed per hr., max.	175
Tons crushed per hr., avg.	110
Power consumption, kilowatt hours	
Peak	80
Idling	14
Avg.	28

Table II—Screen Analyses

Sizing Aperture Through	On	Screen Undersize Per Cent Weight	Crusher Discharge Per Cent Weight	Feed to Rolls Per Cent Weight
	1.050 in.	2.3	6.6	4.5
1.050 in.	0.742 in.	24.9	22.1	26.3
0.742 in.	0.525 in.	19.5	17.1	17.5
0.525 in.		53.3	54.2	51.7
Totals		100.0	100.0	100.0

Table IA—Screen Analysis of Product

Sizing Aperture Through	On	Per Cent Weight
	3-in. ring	31.4
3-in. ring	2½-in. ring	17.8
2½-in. ring	2-in. ring	8.1
2-in ring	1½-in ring	8.0
1½-in ring	1-in ring	8.6
1-in. ring	3 mesh	12.7
3 mesh	14 mesh	7.0
14 mesh	150 mesh	3.3
Through	150 mesh	3.1
Total		100.0

Table IV—St. Joe Type Vibrating Screens

Mesh Through	On	Per Cent Weight	Cumulative Per Cent Weight
	10	0.6	0.6
10	14	5.9	6.5
14	20	10.6	17.1
20	28	14.6	31.7
28	35	9.7	41.4
35	48	7.7	49.1
48	65	6.2	55.3
65	100	5.8	61.1
100	150	3.9	65.0
150	200	3.5	68.5
200	...	31.5	31.5
Totals		100.0	100.0

Table III—Conveyor Data

No.	Material Handled	Belt Details: Length, Feet	Belt Details: Width, Inches	Kind of Drive	Slope per Foot, Degrees	Belt Speed, F.p.M.	Motor, Hp.	Avg. Tons per Hr.
1	Primary crusher discharge	354	24	Belt	20	393	25	105
2	Secondary crusher discharge and screen undersize	205	24	Belt and gears	17	340	10	105
2A	Ore from surge bin	52	24	Direct with reducer	Level	276	3	105
3	Ore from 2A and roll discharge	182	30	Belt	20	565	40	645
4	Ore from No. 3 conveyor	235	30	Belt	(20 to screens — then level)	522	50	645
5	Screen undersize	79	24	(Belt, chain and sprocket)	Level	504	5	105
6	Ditto from 5	88	24	Ditto	20	458	10	105
7	Ditto from 6	163	22	Ditto	22	350	10	105
8	Ditto from 7	245	22	Belt	Level	275	10	105
9	Gravity concentrate	276	16	Belt	20	125	10	2
10	Ditto	32	18	Direct reducer	Level	140	3	60
11	Filter cake—flotation concentrate	36	16	Ditto	Level	100	2	4½
12	Dryer discharge—flotation concentrate	33	18	Ditto	12	100	2	45

Table V—Pumps: Operating Details

Item	Pumping duty	No. Used	Size	Solids: Type	Solids: Tons/24 Hours	Solids: Per Cent	Motor: Hp.	Motor: R.p.M.	Motor: Drive	Intake Pipe: Head	Intake Pipe: Diam.	Intake Pipe: Length	Discharge Line: Vert. Lift	Discharge Line: Diam.	Discharge Line: Length
1	Crushed ore and ball mill product	3	6 in.	Sand	1,350	26.5	35	865	Direct	2.5 ft.	8 in.	5 ft.	48 ft.	6 in.	54 ft.
2	Crushed ore and ball mill product	3	4 in.	Sand	900	30.0	25	1,160	Direct	2.5 ft.	6 in.	5 ft.	48 ft.	6 in.	54 ft.
3	Table tailings	2	4 in.	Sand	580	25.0	30	1,160	Direct	3.0 ft.	6 in.	2.5 ft.	45 ft.	5½ in.	200 ft.
4	Flotation tailings	1	4 in.	Sand	1,142	30.0	10	850	Direct	3.5 ft.	8 in.	4 ft.	15 ft.	6 in.	300 ft.
5	Total tailings—1st stage	1	6 in.	Sand	2,300	32.0	75	1,160	Direct	5.5 ft.	8 in.	12 ft.	.....	.....	.....
	Total tailings—2d stage	1	6 in.	Sand	2,300	32.0	75	875	Direct	....	8 in.	5 ft.	50 ft.	8 in.	4,600 to 6,000 ft.
6	Table concentrate	1	2 in.	Sand	25	6.0	5	1,130	Direct	3 ft.	4 in.	1.5 ft.	8 ft.	2 in.	100 ft.
7	Circulating feed for flotation	1	6 in.	Sand	1,400	24.0	50	850	Direct	3.5 ft.	8 in.	3 ft.	30 ft.	6 in.	70 ft.
8	Cleaner froth and recleaner middlings	1	3 in.	Sand	50	5.7	10	1,120	Direct	4.5 ft.	6 in.	1.5 ft.	27 ft.	3 in.	65 ft.
9	Flotation concentrate	1	3 in	Sand	38	5.5	5	850	Direct	2.5 ft.	5 in.	1 ft.	3 ft.	3 in.	75 ft.

Table VI—Size Spigot, Opening and Distribution to Tables

Cell No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Spigot opening, in.	7/8	13/16	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	⅝	⅝	⅝	⅝	⅝	⅝
Table No.		1		2			3			4		5	6	7	8	9	10	11	12	13

Table VII—Screen Analyses of Classifier Spigot Products. Three Mill Sections Operating

	To Rougher Tables											To Finishing Tables								
Spigot No.	1	2	3	4	5	6	7	8	9	10	11	Spigot No.	12	12	14	15	16	17	18	19	20
Mesh	Per Cent Weight											Mesh	Per Cent Weight								
On 10	3.9	3.0	2.4	1.6	....	....	....	....	....	....	....	On 14	0.7	....	....	....	....	....	....	....	....
On 14	19.7	16.9	17.6	15.1	14.5	18.3	9.3	9.2	7.4	5.8	2.0	On 20	5.3	2.4	0.9	....	....	....	....	....	....
On 20	23.9	21.3	24.0	23.8	22.8	27.0	19.1	18.5	16.9	15.1	8.8	On 28	25.7	17.4	6.8	8.2	....	....	....	....	....
On 28	26.0	25.8	25.7	27.7	30.1	29.8	31.5	31.8	30.8	30.5	27.5	On 35	30.4	27.5	16.3	17.1	3.6	6.3	3.9	2.2	7.8
On 35	12.6	13.6	13.3	14.0	15.2	12.5	18.0	20.1	21.8	23.4	28.2	On 48	24.0	30.9	35.6	33.5	22.0	20.7	19.2	14.2	17.6
On 48	7.7	9.1	8.9	8.9	9.1	7.3	11.9	12.0	13.6	15.7	21.5	On 65	9.6	15.4	29.7	31.8	51.3	44.4	51.2	48.7	36.9
On 65	3.5	5.0	4.2	4.7	4.3	2.8	5.7	5.2	6.0	5.8	8.0	On 100	2.6	4.3	7.7	7.7	18.5	23.8	22.2	29.2	31.2
On 100	1.5	2.5	2.1	2.1	1.8	1.4	2.6	1.9	2.2	2.2	2.4	On 150	0.7	0.9	1.5	0.9	2.6	3.2	2.0	3.5	4.1
On 150	0.4	0.8	0.7	0.8	0.7	0.3	0.8	0.5	0.5	0.6	0.8	On 200	0.3	0.3	0.6	0.4	1.0	0.8	0.5	0.4	1.2
On 200	0.2	0.6	0.2	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.4	Through 200	0.7	0.9	0.9	0.4	1.0	0.8	1.0	1.8	1.2
Through 200	0.6	1.4	0.9	1.0	1.1	0.3	0.8	0.5	0.5	0.6	0.4										

II shows the screen undersize and discharge from the secondary crushers.

The gyratory crushers operate at an eccentric speed of 200 r.p.m. and are adjusted to keep the plus-1.050-in. material about 5 per cent. The product from these crushers, with the undersize from the screen, is conveyed to a surge bin, of 90 tons' active capacity, ahead of the rolls. A Weightometer in this conveyor (No. 2, Table III) weighs the ore. The shift operator reads the tons crushed each hour and records the reading on a blackboard so the shift foreman can regulate his tonnage rate and record his production for each shift.

A 24-in. conveyor (No. 2-A, Table III) from the surge bin discharges the ore onto a 30-in. conveyor (No. 3, Table III), which in turn transfers it onto a 30-in. conveyor (No. 4, Table III), from which it is distributed to twelve vibrating screens by adjustable scrapers.

St. Joe type vibrating screens are installed in parallel, each using 33x84-in. square-mesh screen with 0.095-in. width of opening, No. 15 wire (0.072-in. diameter). They are set on a 37-deg. slope, two screens being driven from a countershaft by a 3-hp., 1,730 r.p.m. motor using V-belt drives from the motor to the countershaft, and from the countershaft to the vibrator shaft. The vibrator is driven at 200 r.p.m., using an eight-tooth cam with $\frac{3}{16}$-in. drop.

Oversize from these screens gravitates by chutes to two 24x54-in. rolls in parallel. A 150-hp. motor drives

Table VIII—Sizing Tests of Ball Mill Feed and Discharge

Mesh	Feed, Per Cent Weight	Discharge, Per Cent Weight
On 10	1.1	.1
On 14	7.6	1.4
On 20	16.9	5.6
On 28	23.0	12.8
On 35	19.5	16.5
On 48	12.4	14.0
On 65	5.7	8.4
On 100	7.8	12.5
On 150	2.9	5.3
On 200	1.8	6.4
Through 200	1.3	17.0

Table IX—Sizing Test of Table Tailings, Flotation Tailings, and Combined Tailings

Mesh	Table Tailings Per Cent Weight	Table Tailings Distribution of Pb	Flotation Tailings Per Cent Weight	Flotation Tailings Distribution of Pb	Combined Tailings, Per Cent Weight
On 14	1.9	2.92	....	....	1.0
On 20	5.7	9.68	....	....	3.0
On 28	12.1	10.96	....	....	6.3
On 35	18.8	21.01	....	....	9.7
On 48	24.9	21.17	....	....	12.9
On 65	21.3	15.85	1.6	1.11	11.8
On 100	11.3	7.82	12.3	8.05	11.7
On 150	2.5	2.66	8.4	4.63	5.4
On 200	(a) 1.5	7.93	17.7	10.68	9.3
Through 200			60.0	75.53	28.9

(a) Minus 150 mesh.

Table X — Type and Consumption of Reagents Used

Reagent	Lb. Ton Dry Slime
Aerofloat No. 31	0.05
Cresylic acid	0.16 to 0.25
Sodium cyanide	0.015 to 0.02

Table XI—Power Consumption

Class of Work	Machine	Per Cent of Total Power Machine	Per Cent of Total Power Total
Dry crushing	Crusher and rolls	23.8	....
	Conveying	8.7	....
	Screening	1.0	....
	Miscellaneous	0.5	....
	Total	34.0	34.0
Wet grinding	Ball mills	12.3	....
	Pumping	7.3	....
	Dewatering, etc.	1.0	....
	Total	20.6	20.6
Tabling			2.7
Flotation			16.6
Gravity concentrate disposal			2.0
Gravity tailings disposal			12.7
Water supply			8.7
Lighting			2.7

Table XII—Plant Organization

Operating	No. Men
Shift foreman	3
Primary crushing	3
Secondary crushing	3
Conveying	3
Rolls	3
Ball mills	3
Ball mills helper	1
Tables	3
Flotation plant	3
Filter and drying	1
Lubricating	1
Total	27

Maintenance	No. Men
Foreman	1
Carpenters	4
Repairmen	7
Laborers	4
Total	16

Table XIII—Metallurgical Results

Distribution of products

Material	Per Cent Weight
Ore treated	100.0
Table feed	37.0
Gravity concentrate	2.1
Gravity tailings	34.9
Flotation feed	63.0
Flotation concentrate	1.4
Flotation tailings	61.6
Total concentrate	3.5
Total tailings	96.5

Distribution of concentrate and lead in concentrate

Material	Per Cent Weight
Total concentrate	100.0
Gravity concentrate	60.0
Flotation concentrate	40.0
Total lead in concentrate	100.0
Lead in gravity concentrate	60.0
Lead in flotation concentrate	40.0

Ratio of concentration	27
Ratio of water per ton of ore	8.9
New water added, gallons per minute	800

each roll, using a countershaft between each motor and roll. A 20-in. six-ply belt is used from the motor to the countershaft and a 24-in. endless-cord belt from the countershaft to the roll, operating the driving roll at 73.4 r.p.m. Draw rods hold the driven roll bearing against shims so the roll shells are spaced about 1/16 in. The idling shell revolves with the driving roll when crushing ore. The faces of the roll shells are hard-faced by electric welding and repaired for wear in the same manner. A large circulating load, varying from 5 to 6 to 1, is carried by the roll circuit. The roll product discharges onto a 30-in. conveyor (No. 3, Table III) and is returned to the St. Joe screens by conveyor (No. 4, Table III), thus making a closed circuit. The screen analysis of the undersize is shown in Table IV.

Undersize from the screens is conveyed by two 24-in. belts in series (Table III, No. 5 and No. 6) to the ore-sampling plant. The discharge from No. 6 conveyor is sampled by the first cutter and then by three other similar cutters in series, a screw feeder mixing and conveying the sample cut to each cutter. In this mill the final cutter divides the sample into equal parts, which are then mixed separately in a rotary drum, coned, and quartered by a mechanical splitter. The ore sample covers a 24-hour period. The check sample is coned and quartered for each 8-hour shift and the average checks within 0.05 per cent Pb of the 24-hour sample. Sample cutters are cars moved by a crank and arm on a track, each car having one sampling and two reject openings. The last car has two equal openings, one feeding the 24-hour hopper, the other the 8-hour hopper. Final samples are dried, ground, and prepared for assaying.

Rejects from each sample cutter are combined and conveyed by two belts in series (Table III, No. 7 and No. 8) to feeder bins for each mill section. A 36x60-in. vibrating screen is installed as a scalping screen between these conveyors to remove any oversize material that may be caused by a defect in screens in the roll circuit. This screen is installed on a 12-deg. slope and is equipped with a square-mesh screen cloth with 0.364-in. opening, No. 14 (0.080-in. diameter) wire, operating at 800 r.p.m. Oversize is returned to the rolls for regrind. Undersize is distributed to the feeder bins by adjustable scrapers on No. 8 conveyor.

The concentrating part of the mill is divided into three sections at this point in the flowsheet, it being possible to operate with full tonnage in either two or three sections. At present, three sections, treating 800 tons each, will give lower gravity tailings. Milling with two sections, at 1,200 tons each, produces somewhat higher tailings. Two sections are used only when making repairs in the other section or when milling a minimum tonnage.

A 24x38-in. pan-type apron feeder and an arc gate regulated by an adjusting screw control the rate of feed from each mill section bin. Each feeder is driven separately by a 2-hp., 1,200 r.p.m. motor, direct connected to a worm reduction gear.

The ore is sluiced in a launder beneath the feeder to a 6-in. sand pump, Item I, Table V, the same pump also handling the ball-mill discharge. The pulp averages 25 to 30 per cent solids and is pumped to a Delano hydraulic deslimer at a total head of 55 ft., the pump efficiency being 30 to 35 per cent.

The ore is deslimed by the hydraulic deslimer, which has a top diameter of 80 in. The spigot discharge, or sands, are classified by a St. Joe 20-spigot hydraulic classifier. Table VI shows the spigot openings and distribution to tables when operating three mill sections.

When operating two mill sections, $\frac{1}{8}$ in. to $\frac{1}{16}$ in. larger openings are used for the first five or six spigots, and the last six spigots are replaced with $\frac{3}{4}$-in. openings. The overflow from the classifier is used as sluicing water for the ore from the feeders to the 6-in. sand pumps. Excess water is bypassed for use as feed water on the roughing tables.

The spigot products from the St. Joe classifier as shown in Table VII are distributed to thirteen concentrating tables in each mill section. Each table makes three products. The rougher tables make a finished lead concentrate, a circulating middling that returns in closed circuit to the Delano deslimer and the St. Joe classifier without regrinding, and a secondary middling which is dewatered by a shovel wheel and reground by a 6x4½-ft. open trunnion discharge ball mill. The ground pulp from the ball mill, together with the overflow from the dewatering wheel, is returned in closed circuit with the original ore to the Delano deslimer and St. Joe classifier for reclassification and retabling. A 4-in. sand pump, Item 2, Table V, operates in parallel with the 6-in. pump when operating two mill sections or if there is an excess of pulp for one pump.

The ball mill operates at 25.7 r.p.m., and is belt-driven by a 75-hp. motor. A charge of 17,500 lb. of steel balls with 1½-in. maximum diameter is used, additional balls being added each day at the rate of 0.2 lb. per ton of ore milled. Circulating load in the ball mill varies from 675 tons for three sections to 850 tons for two-section operation. The pulp density averages 72 per cent solids, with a 6 deg. F. average temperature rise. Sizing tests of feed and discharge are shown in Table VIII.

The finishing tables make a finished lead concentrate, a middling that is returned to the ball mill for regrinding, and a final tailing. Tailings are pumped to a storage pond for final disposal. Two 4-in. sand pumps, Item 3, Table V, pump the table tailings (25 per cent solids) against a 50-ft. head to a 72-in. diameter Delano hydraulic deslimer. Overflow from the deslimer returns to the slime thickeners, a sand trap in the circuit removing any coarse material that might be caused by a choke-up or other interruption. The spigot of the tailings deslimer is sampled automatically by a St. Joe sampler, for assay. The tailings are then pumped by two 6-in. sand pumps, in series, through an 8-in. pipe line to the storage pond above, 4,500 ft. from the plant.

Two storage ponds are in use, the second one being 6,000 ft. from the plant. The pipe lines from the plant are so connected that either pond may be used by two sets of pumps, one set serving as a spare. A 6-in. sand pump, direct-connected to a 75-hp., 1,160-r.p.m. motor, is installed at the head of the farthest pond, and pipe lines run from it around the lower end of each pond, in order to discharge the sands along the dam, keeping it above the water level in the overflow chimneys. Three-quarter inch holes are spaced in the pipe line along the dam so as to distribute the sands when raising the dam. A tunnel under the dam extends into the pond 300 ft. to a concrete tower with overflow openings that can be raised with 4x6-in. blocks to permit the tailings water and rainfall to discharge through the dam and maintain a proper water level in the pond to settle the slime and sands.

Item 5, Table V, gives the operating details for the tailings pumps mentioned in the foregoing.

The discharge head varies from 90-lb. to 100-lb. pressure when pumping to the nearest pond, and 120 lb. to 140 lb. for the farther pond. A five-stage 2½-in. centrifugal pump, 200 g.p.m. capacity at 450-ft. head, direct-connected to a 50-hp., 1,750 r.p.m. motor, furnishes water for the stuffing boxes on the sand pumps and acts as a booster by injecting added water to the pipe line beyond the slurry pump discharge, when pumping to the farther pond.

Lead concentrate from all the concentrating tables is conveyed to a dewatering drag classifier. The concentrate from some of the tables gravitates in launders to the drag classifier, and from the rest of the tables is pumped to the drag classifier by a 2-in. sand pump, Item 6, Table V. This pump discharges through a 2-in. pipe about 100 ft. long at 8 ft. static head. The dewatered concentrate is conveyed by a 16-in. belt (No. 9, Table III) to a 4x1½-ft. concentrate filter. A 10-hp. motor is belt-connected to drive both the conveyor and filter.

The filter is placed over a steel storage tank, holding 70,000 lb. of dewatered concentrates. A slide gate at the bottom of the steel cone permits the concentrates to discharge onto a shuttle conveyor (No. 10, Table III), which delivers to a mechanical box-car loader that distributes to each end of the car. It is then leveled, hand-sampled, weighed, and shipped to the smelter. Shipments averaged from 2 to 3 per cent moisture and 78 to 82 per cent lead. The filtrate from the concentrate filter is returned by a pump to the drag classifier. A 3-in. sand pump, direct-connected to a 5-hp., 850-r.p.m. motor, pumps the overflow from the drag classifier, partly to the table concentrate pump for water supply and partly to the pump carrying the flotation plant concentrate to the flotation concentrate thickener for settling before filtering.

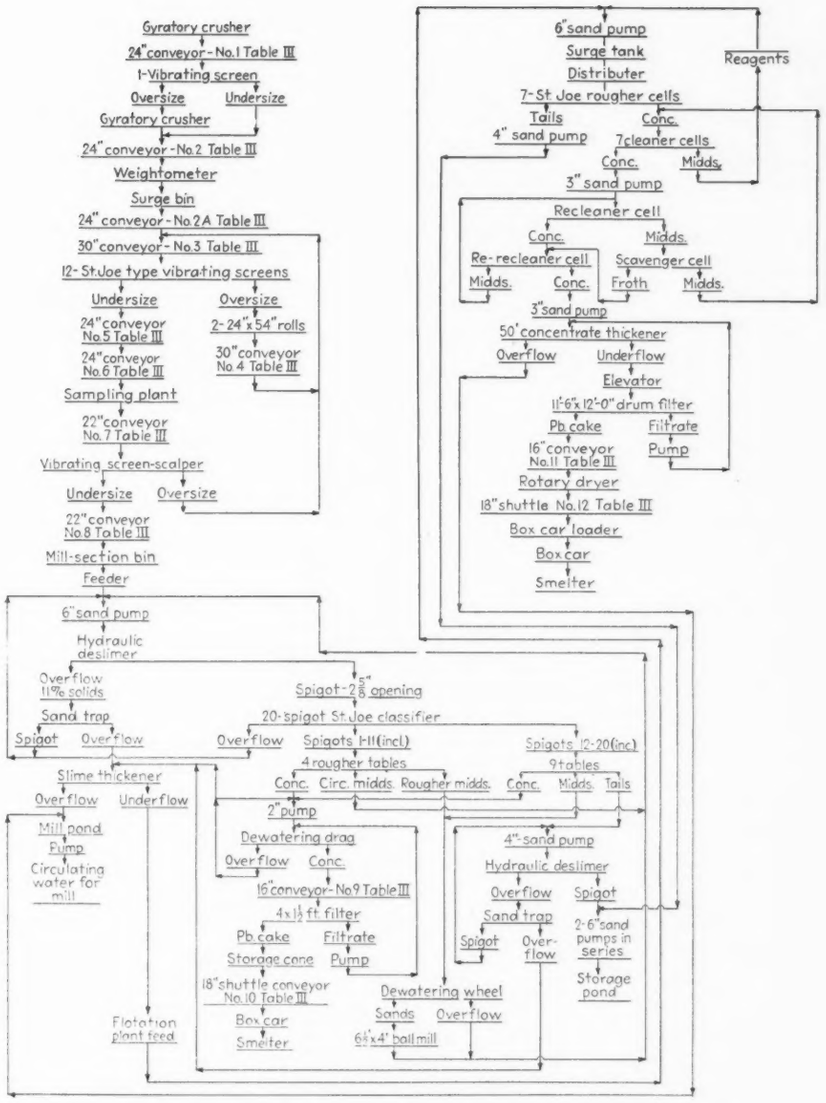
The slimes from the original ore and the regrind in the ball mills overflow the Delano hydraulic deslimers, and then go by launder to a stationary distributor, with weir overflows, to equalize the volume and tonnage to seven 6x50-ft. slime thickeners. A large sand trap is placed in this launder to remove any coarse sands, which are returned to the deslimers by the 6-in. sand pumps, Item I, Table V, to two mill sections.

Overflow from the slime thickeners is returned to the mill circulating water pond and is returned by pumps for re-use in the plant. The underflow, at 32 to 35 per cent solids, is pumped by a 6-in. sand pump, Item 7, Table V, to a surge tank 10 ft. in diameter by 6½ ft. deep. This tank equalizes the flow through a cone-shaped stationary distributor, feeding seven rougher cells.

The flotation machines are of the St. Joe type. Each flotation machine consists of a rougher cell 36 ft. long in series with a cleaner cell 12 ft. long equipped with an individual centrifugal air compressor, driven by an 18-hp., 3,500-r.p.m. motor. This compressor furnishes 4,000 cu. ft. of free air per minute at ¾-lb. pressure per square inch. The weir overflow at the tailings end of the rougher and the cleaner cells is maintained at an 18-in. depth.

The rougher cells make a final tailing, assaying 0.14 to 0.18 per cent Pb, which is sampled by a St. Joe automatic sampler, and then pumped by a 4-in. sand pump, Item 4, Table V,

THE BRIDGE STRUCTURE reaching to the center of the new Bonne Terre tailings dam terminates over a concrete drainage shaft. As the dam builds up, concrete blocks are added, making the shaft high enough to permit clear water to drop into the drainage tunnel shown on page 287



THE BONNE TERRE FLOWSHEET shows the general practice employed by the other three mills with exception of capacity, plant layout, size, and type of crushers and other equipment

through a 6-in. pipe line 300 ft. long at 15-ft. static head, to the chat tailings disposal pumps for storage in the settling ponds.

The rougher froth from each cell, assaying 15 to 18 per cent Pb, gravitates to the cleaner cell in each unit. This cell makes a middling that is returned by the 6-in. sand pump with the original feed and recirculated through the rougher cells in closed circuit, at a density of 24 per cent solids. Reagents are added to the launder returning the middlings from the cleaner cells to the pump. Mechanical feeders regulate the reagents used.

The amount of cresylic acid used varies with the temperature of the pulp, more being needed in the summer than in the winter.

Cleaner-cell froth is pumped to a recleaner cell by a 3-in. sand pump, Item 8, Table V, through a 3-in. pipe at 27-ft. static head. Water sprays break down the froth to this pump. The recleaner cell is direct-connected to a centrifugal compressor, 1,600 cu. ft. free air per minute capacity at 1-lb. pressure, driven by a 12-hp., 3,500 r.p.m. motor. Each cell is 12 ft. long and is installed at a lower elevation than the preceding one, to permit the flow of products in series.

The cleaner froth, 60 to 64 per cent Pb, feeds the first, or recleaner, cell. Middling from this cell feeds the second, or middling cell, and the middling from it is returned with the rougher froth to the original cleaner cells, thus closing the circuit. Froth from the recleaner and middling cells goes to the third, or recleaner, cell, where a final concentrate is made. Middling from the last recleaner cell is returned with the feed to the first recleaner cell. A 3-in. sand pump, Item 9, Table V, pumps the final concentrate, 74 to 77 per cent Pb, to a 50-ft. concentrate thickener for settling. The rakes in this thickener make one revolution in ten minutes.

Overflow from this thickener returns to the mill circulating water pond. The underflow, at 75 per cent solids, is fed, by a bucket elevator, to a drum-type filter, 11 ft. 6 in. diameter by 12 ft. long, which makes one revolution in 6⅔ minutes. Vacuum from 20 to 22 in. is furnished by a 14x8-in. vacuum pump driven at 238 r.p.m. by a 25-hp. motor using a multiple V-belt drive, nine ropes $\frac{7}{8}$x$\frac{5}{8}$ in. The filtrate is returned to the thickener by a 2-in. centrifugal pump.

The filter cake, averaging 12 to 14 per cent moisture, is conveyed by a belt (No. 11, Table III) to a 36 in. by 20 ft. rotary dryer, using natural gas for fuel. A hood at the discharge end of the dryer receives the dried concentrate, averaging 5.5 to 7 per cent moisture, and discharges it onto a shuttle conveyor (No. 12, Table III), which can be moved in and out of a box car. This conveyor discharges to a mechanical box-car loader, which spreads the concentrate in each end of the car. The car is then hand-sampled, weighed, and shipped to the smelter.

A hopper is placed in the flue from the dryer, to trap any fine dust, which is returned to the box car. Gas pressure on the burners varies from 5 lb. to 21 lb. and is regulated by the operator according to the quantity of filter cake being dried, care being taken to prevent dusting in the dryer. The weight of concentrate being dried varies from 5,000 to 11,000 lb. per hour. Both filter and dryer operate only about 40 per cent of the milling time in order to handle the output.

Electric power is 3-phase, 60 cycle current stepped down to 440 volts for dry crushing, including the rolls, and to 220 volts for the rest of the plant.

Synchronous motors are used on two ball mills, some of the tables, and the mill circulating water pump. The rest are of the induction type. A distribution of the power is shown in Table XI.

The plant operates three 8-hour shifts, using 27 operators and a small crew of maintenance men, who work part time when running and part time when the plant is idle, to make the necessary repairs and alterations. Distribution of the labor is shown in Table XII.

Repair parts are made in the machine shop for replacements and the electrical shop attends to all the electrical equipment.

Metallurgical results are shown in Table XIII.

Make-up water is obtained from surface rainfall and underground drainage. This water is stored in a small lake and is piped to the circulating water pond at the mill, to replace the water lost by tailings disposal.

Gold Rumors

Adverse effect on domestic recovery is only one of several weighty reasons why price of gold will not be lowered—Production need not be curtailed—Maldistribution should be rectified as equilibrium in world economy is established

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MONETARY RUMORS during good times disturb the course of business, and in the present atmosphere of nervous tension and uncertainty they seem to exert a still more serious influence, impeding the progress of world economic recovery. The President in March called attention to the rapid vertical rise in commodity prices, probably having in mind principally the prices of copper, lead, zinc, rubber, and other products the prices of which are determined largely in the world market. The President also referred to the large amount of foreign capital, some 7.5 billion dollars, invested in American industrial securities and the possible danger to our domestic economy which might result from a rapid withdrawal of these funds. In fact the Treasury Departmen by direction of the President made a detailed analysis of how these funds were invested. Then followed the London rumor that the Administration at Washington was about to reduce the price of gold from $35 to $30 and even to $25 per ounce. In this plausible setting the rumor was given great credence, gold shares on the world's exchanges were promptly discounted, other industrial shares declined sharply, and commodities were sold in large quantities, resulting in the deflation of security and commodity prices. Foreign capital invested in American securities was withdrawn by liquidation and the decline in the values of American securities was accentuated. Apparently no effort was made accurately to appraise the American economic position and the desirability of reducing the price of gold. Notwithstanding statements of the President and the Secretary of the Treasury that no change in the price of gold was being considered, and the opinions of monetary authorities both here and abroad in support, the deflationary reaction to the rumor did not terminate and still persists. A critical analysis of the situation would seem to be justified and it may prove helpful in considering the validity of this gold price rumor and other rumors that may occur in the future.

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The United States is far from complete economic recovery, and the unemployment problem, which is causing the government such heavy costs at the expense of the taxpayers and is making budget balancing impossible for the present, has still to be solved. The remainder of the world has advanced further than has the United States in economic recovery and no unemployment problem on any serious scale exists abroad. It is, therefore, reasonable to conclude that this country would suffer more than the rest of the world by action reducing the price of gold. It would precipitate an extensive and prolonged deflation, industrial stagnation on a large scale, an an increase in unemployment. Why would the Administration take action which would be so adverse to our domestic economy, especially at a time when progress is being made in economic recovery? If there were no other reasons for this country not lowering the price of gold, this reason alone would seem sufficient. But there are numerous other reasons why the Administration either could not or would not reduce the price of gold which should be considered.

As originally enacted the law granting to the President the authority to change the weight of the gold dollar included the following proviso: "but in no event shall the weight of the gold dollar be fixed so as to reduce the present weight by more than 50 per centum." However, the Congress made a vital change in this provision in the Gold Reserve Act of 1934, passed on Jan. 30, 1934, when the following limitation was incorporated: "nor shall the weight of the gold dollar be fixed in any event at more than 60 per centum of its present weight." The President by proclamation on Jan. 31, 1934, reduced the weight of the gold dollar 59.06 per centum, or to 15 5/21 grains of gold nine-tenths fine, equivalent to $35 per ounce. The President, therefore, has no legal authority to reduce the price of gold from $35 to $25 per ounce. For the "Inactive Gold Account," the Secretary of the Treasury is compelled to pay the statutory price of $35 per ounce for all of the new gold produced in the United States. Congress would have to pass an amendment to the Gold Reserve Act of 1934, increasing the weight of the gold dollar to 21 1/3d grains of gold nine-tenths fine, before the price of gold would be reduced to $25 per ounce.

The Administration inspired the agreement between Great Britain, France, and the United States to stabilize currency and remove trade barriers, and consequently would be reluctant to withdraw from the accord, an act which would be inescapable if the United States were to decrease the price of gold from $35 to $25 per ounce. Great benefits to foreign trade have occurred since Sept. 25, 1936, when this currency accord was signed, through the removal of trade obstacles and the greatly improved stability of the pound, franc, and dollar. These are economic advantages which are increasing as time passes and cannot be lightly appraised in improving domestic and world economy. In order to emphasize the nature and extent of the obligations assumed by the United States when the Tripartite Agreement was signed, the memorandum of Sept. 25, 1936, Paragraph 2 is quoted in part as follows: "*one constant object of which is to maintain the greatest possible equilibrium in the system of international exchange and to avoid to the utmost extent the creation of any disturbance of that system by American monetary action.*" Nothing could disturb the monetary system more than arbitrary action by the United States reducing the price of gold from $35 to $25 per ounce.

In addition to the generally adverse deflationary affect on American domestic economy of reducing the price of gold, there are other repercussions on the budget status of the nation which should be considered. The daily statement of the United States Treasury on May 12, 1937, shows a total gold stock of 11,883 million dollars. A reduction in the price of gold from $35 to $25 per ounce, or about 28.57 per cent, would automatically reduce the monetary gold stock 3,395 million dollars, and by this amount the disparity in budget balance would be increased. Furthermore, such a reduction of gold stocks would necessitate the "revitalization" of some 3 billion dollars of gold by rescinding the "sterilization" orders by the Federal Reserve Board increasing the gold reserve requirements on Aug. 15, 1936, and March 1 and May 1, 1937. The loss to the Treasury of so much gold and the reversal of gold reserve policy would both have serious domestic reactions. Whatever benefits through the profits of devaluation of Jan. 31, 1934, which have accrued to the Treasury would be largely dissipated and the budget would become far more difficult to balance.

In the Treasury statement of the gold stock of May 12, 1937, the item of gold in the general fund "Inactive" amounted to $650,889,711.99. This is

the gold imported, newly produced in the United States, or scrap gold from the industrial arts, purchased with funds derived from the sale of Treasury bills since December, 1936, when the policy was put into effect to establish an "Inactive Account," and thus prevent the enlargement of our monetary gold reserves. This policy has been attacked on the ground that the government is paying interest on the Treasury bills sold and that the burden of credit is being unnecessarily increased, with resultant difficulties in maintaining the value of government bonds. This policy if found burdensome could easily be replaced by an amendment to the Federal Reserve Act providing for larger gold reserve requirements. At present the gold reserve limit has been reached, but it would not take long to enact such an amendment and integrate the "Inactive" gold in the banking system.

The underlying reason for the President's apprehension in March because of the rapid vertical rise in commodity prices was reported to be his desire to prevent, if possible, a runaway "boom," in which the cost of living would be forced above the income level. For the reason that the Government will for some time be unable to balance its budget and will be compelled to finance itself by the continued use of Federal credit, the long period forecast is for continually, but preferably gradually, rising prices and costs of production. However, there is an activity which lies outside of the Government which could accomplish much in lessening the extent of the inflation. Wages are being increased under the pressure of labor conditions and to meet the rising cost of living. If industry generally will take full advantage of lowering production costs through the elimination of obsolete machinery and the installation of the most modern and improved methods of manufacture, it will reduce materially the amount of the wage increase to be passed on to the consumer. Those industries that attempt to pass on increased costs, including the higher costs resulting from the operation of obsolete equipment, may be confronted with a limited consumer purchasing power and be compelled to curtail output and to assume the additional burden of increased unit costs of production. Such a national campaign to obtain minimum production costs, especially in the mining industry, would accomplish much in stabilizing prices and costs of production despite the inflationary influences of Federal finance.

The question of controlling the production of new gold is being discussed on the basis that there is a glut of gold and that the excess of newly produced gold is causing inflation. If the automatic gold standard of the pre-War period were now universally in operation, the increasing world gold output since 1931 would have been added to the monetary gold reserves of the gold standard nations, and the volume of new credit and currency created would undoubtedly have resulted in a gold inflation of large proportions. During the last four years entirely different conditions have prevailed. The "Federal Reserve Bulletin" shows that the monetary gold reserves of 52 of the principal countries in December, 1932, amounted to 20,143 million dollars, at $35 per fine gold ounce, and in December, 1936, amounted to 22,663 million dollars, an increase for the four years of 2,520 million dollars, or 12.5 per cent, or an annual average increase of 3.1 per cent, the rate of increase usually conceded to be necessary in the conduct of normal business activity and expansion. The total of world gold production for 1933, 1934, 1935, and 1936 amounted to 4,197 million dollars, which is more than the increase in national monetary gold reserves during the same period by 1,677 million dollars, or 66.5 per cent.

The net imports of gold into the United States for 1934, 1935, and 1936 amounted to 3,990 million dollars, an amount greater (by 681 million dollars) than the world's gold production for this period of 3,309 million dollars. By order of the Federal Reserve Board the increases in gold reserve requirements of Aug. 15, 1936, and March 1 and May 1, 1937, sterilized 3 billion dollars of this imported gold. The "Inactive Gold Account" contains 650 million dollars of sterilized gold. Though no data are available there is a large quantity of gold in national currency stabilization funds, and in private hoarding, which cannot be used for the creation of credit and is, therefore, sterilized. With an amount of gold probably twice the amount of the newly produced gold of the last three years sterilized, it is reasonable to conclude that we are not suffering from a gold inflation. Consequently there would seem to be no need for compelling a decrease in the gold production of the world, either by greatly reducing the price of gold or by any other means. The rising costs of gold production will tend to limit the world's output of gold, and as equilibrium is established in world economy the demand for gold will be greatly increased by the necessity of many nations to expand their monetary gold reserves. Gold now sterilized will be released for sale to those nations desiring to improve their monetary positions and there is more likely to arise the question as to whether there is sufficient gold to meet the future monetary demand than that there will be an excess. To arbitrarily or artificially limit gold production now would indeed be premature and might result in prolonging the severity of economic depression for many years.

The heavy inflow of gold into the United States on the basis of long-trend consideration is but a temporary phenomenon. Other countries are acquiring more gold and will require more as soon as it can be utilized to good advantage. When the gold tide does turn, the sterilized gold now held by the United States as custodian can be immediately released without danger to our monetary position. Premier van Zeeland of Belgium is now conducting an official monetary research the results of which it is reported he is to discuss with the President in June. In some quarters an international economic conference is being recommended. The Secretary of the Treasury, however, let it be known on May 20 that he was opposed to international conferences and expressed the belief that better results could be achieved through conferences with individual nations. The Secretary pointed out that the Tripartite Agreement between Great Britain, France, and the United States, and which was later joined by Switzerland, the Netherlands, and Belgium, was the result of individual conferences. Whatever method is employed, it is important that more nations join the currency stabilization accord and that as many nations as possible enter upon mutually beneficial trade agreements, adjusting tariffs, removing exchange restrictions, and in modifying or removing other barriers to the conduct of foreign trade. The more rapid the progress in this direction the sooner may we expect a reversal in the gold movement to this country. Foreign trade should also show marked improvement.

It is too early in the cycle of monetary evolution to formulate the provisions of the future modernized gold standard ultimately to be universally adopted. However, it is becoming more evident that the monetary system of the future probably will be partly automatically controlled and partly managed. Economic recovery from the world's most serious economic crisis is of first importance, and the attention which this demands necessarily delays and makes more difficult the development of a satisfactory monetary system for the future. That a major evolution in monetary method and practice is now in progress there can be no question. Though the development of the new monetary system may move slowly during the course of economic recovery, greater permanence of satisfactory operation may be expected. Consequently rumors of vital fundamental changes in the monetary order should be considered as evidences of the difficulties now being experienced in re-establishing normal economic conditions and not as serious efforts to change the fundamental character of monetary objectives.

Blasting Accidents

Can Be Eliminated

III. Picking into explosives in the muck pile . . . Explosives and heat . . . When capping fuse . . . Stepping on a cap . . . Handling broken rock . . . In burning trash . . . A falling chute bomb

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▶ELEVEN *different typical accidents that occur in blasting work have been dealt with in the preceding two installments of this article, which appeared in the March and April issues, respectively. Messrs. Soule and Williams conclude their treatment of this important subject of safety in blasting with a discussion of seven additional typical and dangerous mishaps, which are presented in the following paragraphs:*

TYPES OF ACCIDENTS

XII . . . *Picking Into Explosives in the Muck Pile*

▶Possible Causes:

1 Surplus explosives left from loading.
2 Explosives from cut-off holes.
3 Explosives pulled or blown from hole through lack of tamping or stemming.
4 Explosives not being distinguished from the rock, due to the color of the wrapper.
5 Picking or loosening the muck pile by blows from the pick instead of using a hoeing or raking motion.
6 Capping fuses at face and caps being dropped unnoticed.

▶Suggested Preventative:

FUSE BLASTING: When loading a round, all explosives should be piled neatly on a smooth surface. Any explosive remaining after the loading is completed should be returned to the explosive magazines. Stemming or tamping should always be used, not only to increase the efficiency of the blast, but also to prevent the explosive from being blown or pulled from the hole.

When loading a round, always split all sticks of dynamite, except that used for the primer. Force each stick into the hole (except the primer), thereby expanding the explosive and filling the hole. This increases the efficiency of the blast and prevents the explosive from being pulled out.

All dynamite should come wrapped in *red* wrappers[1], and tamping or stemming should be put in white shells. This makes the dynamite easy to see in the broken rock. Where the rock being blasted is of a red color, some other contrasting and conspicuous color can be used for wrapping the dynamite.

All fuse should be capped at a central magazine. It is poor practice to cap fuses at the face, as some of the loose blasting caps may be left on the floor of the drift.

ELECTRIC BLASTING: All blasting wires should be removed from the muck pile as soon as discovered and examined for live blasting caps. The safety primer is less dangerous in a muck pile than a live primer, because it has no dynamite in connection with it, and the blasting cap is protected to a great extent by the wooden block into which it is fastened.

XIII

Explosives Coming Into Contact With Heat

▶Possible Causes:

1 Deliberate placing of the explosive in the flame of lamp.
2 Carrying explosives uncovered and unprotected.
3 Improper or insecure placing of the lamp while loading at the face, and the lamp dropping on the explosive.
4 Accidental passing of the explosive through the flame of the lamp.
5 Using open lights in an explosive magazine.
6 Smoking while handling explosives.

▶Suggested Preventative:

FUSE BLASTING: No person should be allowed to handle explosives until that person has been thoroughly instructed in the safe standard practices by a competent instructor and has, by actual demonstration, proved that he is thoroughly competent to handle them.

No person should ever be allowed to go around any place where explosives are used without first being cautioned about the dangers arising from the careless handling of them.

All explosives should be transported in a fireproof or a fire-resisting receptacle. Cars used in handling them must be properly insulated against electric current and fire.

When loading at a face, the lamp should be so hung or placed as to make it impossible for it to come in contact with the explosives through falling from its support.

Vapor-proof incandescent lamps, properly fused, with all wiring in conduit, should be the only type used in an explosive magazine. The use of electric storage-battery cap lamps greatly minimizes the chances of explosives coming in contact with open flames.

Smoking must be prohibited when handling explosives or when in or around explosive magazines; also when assisting in the transportation of explosives.

ELECTRIC BLASTING: Where the safety primer is used, the blasting cap is almost entirely covered with wood or some other non-explosive material which makes the caps comparatively safe to handle. This covering also

[1] One large manufacturer of explosives states: "We supply dynamites in red shells only when so specified on orders. We have a number of customers who desire red shell, although in percentage of total volume this is well below 5 per cent of the total. Red shells are sometimes desired for easier identification in case of theft and at other times to facilitate locating powder in the material shot, in case of a missed hole. Red wrappers are standard for our black pellet powders, as well as for some of our competitors' pellet powders."—EDITOR.

protects the cap against premature explosions caused by coming in contact with the flame of a lamp, by dropping, or by friction with the rock during transportation.

XIV

Blasting Cap Exploding While Capping Fuse

▶Possible Causes:

1 Not using the proper tools for crimping.
2 Rough handling.

▶Suggested Preventative:

FUSE BLASTING: All fuses should be capped in a central magazine and only standard tools or equipment, approved by the manufacturers of explosives, should be used for this purpose. The teeth, a knife, rock, or other makeshift device should never be employed.

When inserting the fuse into the blasting cap, be sure that the fuse is squarely cut off. Insert it in the cap so that it just comes into contact with the fulminate. Never force it into place.

Avoid the rough handling of blasting caps at any time. They are very sensitive to either shock or friction.

ELECTRIC BLASTING: The use of electric blasting eliminates the necessity of capping fuse, as it is more convenient to secure electric detonators already made up.

XV

Stepping on Blasting Cap or Otherwise Coming Into Contact With Explosives While Working

▶Possible Causes:

1 Allowing loose blasting caps to be taken from the magazines.
2 Cutting blasting cap from fuse so that the fuse could be used for other purposes.
3 Improperly or insecurely crimping blasting cap to the fuse so that it falls off.
4 Encountering a blasting cap from a primer that has failed to explode.
5 Capping fuses at other places than at the magazines.
6 Not requiring men to return unused explosives to the magazines.
7 Drawing explosives from a magazine without orders from the boss.
8 Hiding explosives with the intention of using later.

▶Suggested Preventative:

FUSE BLASTING: All fuses should be capped at a central magazine. No loose blasting caps should be allowed to be taken from a magazine. Explosives should be issued only upon written orders of the boss or other authorized persons.

Capped fuses in the magazine should be inspected from time to time to make sure that they have been properly and securely crimped to the fuse.

Explosives should be transported in suitable sacks or other containers so that they cannot be dropped, unnoticed, during transportation.

All unused explosives must be returned to the magazines at once. Many men are injured by stepping on blasting caps carelessly dropped in the drifts, or by coming in contact with explosives hidden behind timber and in other places. It is important that explosives be handled throughout their course from the main storage magazine to the working face upon written orders only.

ELECTRIC BLASTING: It is important that the same precautions that govern fuse blasting be followed when handling electric primers. The safety primer, because of its protective covering, is less hazardous to handle than the live primers and the bare blasting caps.

XVI

Explosives Going Off While Handling Broken Rock

▶Possible Causes:

1 Excess explosive left on the floor of a shrinkage stope or other working place after loading holes.
2 Explosives left in boulders due to cut-off holes.
3 Excessive number of holes drilled in a shrinkage stope.
4 Holes firing out of rotation due to improper trimming of the fuses.
5 Not using tamping, and explosives dropping from vertical holes.

▶Suggested Preventative:

FUSE BLASTING: In drilling in a shrinkage stope, the boss should check the miners to see that there is the proper amount of burden upon each hole, so that one hole does not have a tendency to cut off an adjacent hole, thus allowing loose explosive to get into the broken rock of the stope or in holes in the larger rocks.

When loading holes in a shrinkage stope, all explosives should be carefully piled on a smooth, tight floor; a plank flooring should be built for this purpose. Explosives scattered around a stope are likely to be lost in the crevices between the rocks.

Always use two sticks of tamping or stemming in all holes and tamp tightly in place so as to prevent the explosive from dropping from the holes.

Miners must be thoroughly instructed in the proper method of trimming their fuses so as to insure that they will fire in the proper rotation. The order of spitting alone is not sufficient to insure the proper rotation.

ELECTRIC BLASTING: The greatest danger that arises from encountering explosives in a muck pile is from an unexploded primer. If electric blasting is used, all detonators are ignited at the same time, and even though one hole cuts another off, the primer will still explode.

Inasmuch as in the safety primer the blasting cap is covered with wood, it is less liable to be set off by the movement of the broken rock, and should it explode, it will do less damage than a live primer.

In shooting out pillars in heavy ground with electric blasting all holes can be shot instantaneously. This system has been found to give a good shattering effect to the rock and is an advantage from a safety standpoint over progressive blasting. With progressive blasting of pillars the first few holes going off will often weaken the pillar to such an extent that it crushes and cuts off many of the remaining holes before they have shot, thus leaving an excess of explosive in the broken rock.

XVII

Explosives Going Off While Burning Trash

▶Possible Causes:

1 Explosive boxes not cleaned out.
2 Paper from empty dynamite boxes having dynamite left in it.
3 Dynamite concealed in sawdust from empty boxes.
4 Explosives remaining in timber that has been shot out.
5 Carelessness in letting explosives get on the floor of explosive magazines.
6 Failure to inspect empty cap cartons or cap boxes.

▶Suggested Preventative:

FUSE BLASTING: Great care must be taken in disposing of trash from explosive magazines. All papers must be carefullly folded and the sweepings carefully inspected for blasting caps. The bench upon which fuses are capped should be tightly made and should have a raised beading entirely around the top of it. The magazines should be provided with a lock, and only authorized persons should be allowed in them. They should be kept scrupulously clean, regardless of the amount of explosives stored. As dynamite is removed from the boxes,

the paper lining should be tightly folded. The sawdust should be passed through a screen of not greater than ½-in. mesh to catch any powder concealed in it. All empty blasting-cap cartons in which electric blasting caps are shipped must be torn apart and folded. Empty cap boxes should be opened and inspected for caps.

All timber salvaged from the mine, especially that from repair work, should be carefully examined for unexploded primers or sticks of dynamite that were placed in it to blast it out.

XVIII

Bomb Falling Down a Chute and Exploding on the Level Below

►Possible Causes:

1 Movement of rock.
2 Bomb insecurely placed.
3 Spitting the fuse before placing the bomb, resulting in hurried work, causing insecure placing of the bomb due to the vision being obscured by the smoke.
4 Too frail a blasting stick used.
5 Bombs insecurely tied to the blasting stick.
6 Bombs being loosely made and thereby falling apart.

►Suggested Preventative:

FUSE BLASTING: Bombs should be securely made by tying the sticks of dynamite tightly together in at least two places with good strong twine. The fuse must never be used for tying them. The primer should be placed in the center of the bomb to prevent it from coming in contact with the timber or rock lining of the chute. The fuse should never be spit before placing the bomb in the chute, as the smoke from the burning fuse obscures the vision. A fuse long enough to reach from the hang-up to the door of the chute should be used, even though it is necessary to prepare a special fuse for each bomb. It should not be necessary to say that a person should never crawl inside of a hung-up chute to place a bomb or to light the fuse.

ELECTRIC BLASTING: With electric blasting, one end of the lead wires can be attached to the leg wires of the primer of the bomb before the bomb is placed. Sufficient time can then be taken to place the bomb where it will do the most good. At the same time it can be placed securely in the chute. With this practice there is always sufficient time for the chute blaster to get in the clear before firing the bomb. Any number of chutes can be blasted simultaneously from the same firing switch through the use of "0" delay blasting caps. This method prevents one shot from dislodging a bomb in an adjacent chute.

When using the safety primer, the primer is tied to the outside of the bomb. When making up a safety primer for bombs, the blasting cap is not brought closer than ¼ in. to the end of the plug. Thus the blasting cap is entirely surrounded by the wooden plug and is thoroughly protected, inasmuch as the bare cap cannot come in contact with any othernot object while it is being placed in the chute.

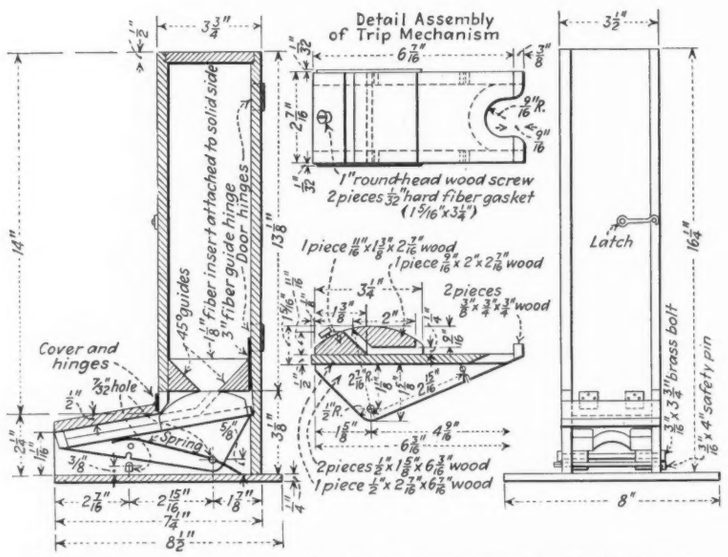
Special clips or some other similar device should be placed on the timber at the entrance to the chute. The lead wires are then so fastened to these clips that, should the bomb fall, the weight of the bomb would pull the lead wires out of the clips and thus break the electrical circuit. The breaking of the electrical circuit prevents the bomb from exploding.

▼ ▼ ▼

A Novel Blasting Cap Dispenser

ORDERLY HANDLING and storage of blasting caps in the fuse preparation room is of paramount importance if accidents are to be avoided and the production of fuses is to be speeded up. To leave blasting caps unprotected on the table or bench is dangerous, as a tool dropped accidentally might easily cause one to explode. To make such an occurrence impossible, the research department of Anaconda Copper Mining Company, Butte, Mont., developed and installed in all fuse rooms, underground and on the surface, the novel blasting cap dispenser shown in the accompanying sketch.

Constructed entirely of wood and lined with fiber segments at points subject to wear, the device contains a storage chamber, accessible through a small hinged door, and a trip mechanism. The hopper-like bottom of the storage chamber is formed by two triangular pieces of fiber on the front and end walls of the box. The piece on the end wall is provided with a fiber guide hinge. Withdrawal of blasting caps is accomplished by a simple trip mechanism in the lower part of the box, which consists of a wooden lever held by a brass pin.


Detail Assembly of Trip Mechanism
3¾"
6⅞"
3½"
14"
13⅜"
16¼"
45° guides
⅛" fiber insert attached to solid side
3" fiber guide hinge
Door hinges
1" round-head wood screw
2 pieces 1/32" hard fiber gasket (1 5/16" x 3¼")
1 piece 11/16" x 1⅜" x 2 7/16" wood
1 piece ⅜" x 2" x 2 7/16" wood
2 pieces ⅜" x ¾" x 3" wood
Latch
Cover and hinges
7/32" hole
Spring
2 pieces ½" x 1⅝" x 6¾" wood
1 piece ½" x 2⅛" x 6⅞" wood
¾" x 3¾" brass bolt
¼" x 4" safety pin
8"

Sketch of construction detail of blasting cap dispenser made entirely of wood

As will be seen, the caps leave the hopper of the storage chamber through the slot in the arched head of the rocker and roll onto the flat extension of the rocker, whence they are removed as wanted. Clogging of caps in the storage chamber can be avoided by actuating periodically the lever extending from the feed chamber, which in turn operates the fiber guide held by the guide hinge on the end wall and thus stirs up the caps in the chamber.

Boise Basin Gold

Remote mine with marginal ore earns profit, milling 100 tons per day by amalgamation, with 92 per cent recovery

John B. Huttl
Assistant Editor

AMALGAMATION MILL of Talache Mines, Inc., at its Gold Hill property at Quartzburg, Idaho. Its capacity is 100 tons of ore per day

AT THE SOUTHERN BORDER of Quartzburg, on Granite Creek, about 35 miles northeast of Boise, Idaho, Talache Mines, Inc., is operating the largest lode mining property in the Boise Basin—the well-known Gold Hill mine. Though a comparatively modest producer of gold, the enterprise is noteworthy in that operations are conducted on a profitable basis despite handicaps such as marginal ore values combined with a moderate daily production and remoteness of locality.

Development of the mine started as early as 1864, two years after the discovery of the gold placers in the Basin, and, with the exception of periods of idleness from 1900 to 1908 and 1926 to 1927, it has produced steadily ever since. The present company acquired control of the property in 1927, and immediately began a comprehensive development program, which culminated with the erection of a mill in 1929. This mill and the entire surface plant were completely destroyed by a forest fire in 1931. After this event, operations were conducted on a modest scale, with activities confined chiefly to underground development, until a contract was entered into with the Harris Mining Corporation late in 1934. This resulted in an increase in the scale of operations from 30 to 100 tons a day, and the provision of a larger surface plant, including a modern 100-ton mill. The contract expired in October, 1935, and since then all operations have been carried on by the present company.

In its geology, the Quartzburg mining area is interesting. The country rock is granite into which have been intruded diorite and rhyolite porphyry dikes. Numerous parallel rhyolite dikes crop out across a width of half a mile or more, and several older diorite porphyry intrusives occur approximately parallel to the rhyolite dikes, striking slightly north of east

HEADFRAME and crushing plant at the Gold Hill mine, at Quartzburg. The property has been developed to a depth of 1,265 ft.

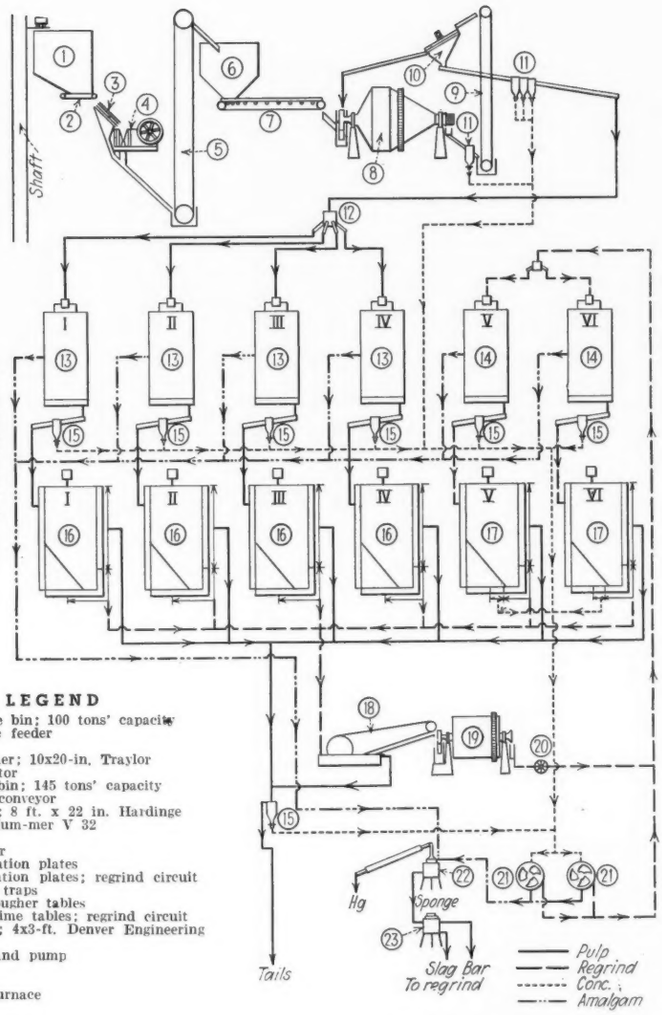
with a dip of 75 to 80 deg. northwest. A younger rhyolite dike strikes across the older formations at an acute angle.

The orebodies occur in an area from 200 to 300 ft. in width, which constitutes a shear zone or system of fractures striking N. 52 deg. E., diagonally across the porphyry dikes, and dipping on an average of 80 deg. southeast. The shear zone is composed of a system of fractures and planes of faulting, and these shattered zones define the stopes, which vary in width from 3 to 40 ft. Due to the shearing having an opposite dip to the dikes, the orebodies rake east, and some have quite a strong rake.

Within the shear zone the area has been subjected to much minor faulting, striking both with the shearing and across it. Quartz was the first mineralization and filled the fractures and fissures, some of which are hairlike, and few exceed a width of 1 to 3 in. The quartz was itself fractured by later minor faulting and became a matrix for later mineralization by native gold and lead-bismuth sulphide. The association of gold with lead-bismuth is intimate, but the gold is entirely free. Bismuth is considered the indicating mineral. In view of the fact that the values are all concentrated in small seams and the adjacent country rock is practically barren, elaborate sampling is necessary and small prospect drifts must frequently be driven from the sides of the stopes to determine the limit of the ore. Present practice calls for an average of 30 samples a day.

The mine has been developed to a depth of 1,265 ft. The ore is hoisted through the two compartments of the shaft in 19-cu.ft. end-dump cars resting in cages operated by a double-drum hoist direct-connected to a 150-hp. motor. Intermediate levels are maintained at 100, 250, 400, 500, 600, 700, 900, 1,100, and 1,265 ft. The greater part of the ore treated at the mill is mined from orebodies under exploitation on the 700, 900, and 1,100 levels. Development drifts are 4x7½ ft. inside the timber, and blocked-out ore is mined exclusively by square-set-and-fill stoping. Under this method, barren ground can be left in place and much of the waste can be sorted out in the stopes and used for filling.

A departure from standard practice is the use of the stope raise set explained in an accompanying sketch. To provide greater safety for the men, better access to the water and air lines, and speed up delivery of materials, the manway is carried 10 in. longer than is usually the practice. The boarded timber slide effectively separates and protects men and equip-



AMALGAMATION accounts for the recovery of 92 per cent of the precious metal in the Gold Hill ore treated by this flowsheet

LEGEND

1. Coarse-ore bin; 100 tons' capacity
2. Coarse-ore feeder
3. Grizzly
4. Jaw crusher; 10x20-in. Traylor
5. Dry elevator
6. Fine-ore bin; 145 tons' capacity
7. Fine-ore conveyor
8. Ball mill; 8 ft. x 22 in. Hardinge
10. Screen; Hum-mer V 32
11. Traps
12. Distributor
13. Amalgamation plates
14. Amalgamation plates; regrind circuit
15. Amalgam traps
16. Wilfley rougher tables
18. Wilfley slime tables; regrind circuit
19. Ball mill; 4x3-ft. Denver Engineering Works
20. Wilfley sand pump
21. Mullers
22. Retort
23. Melting furnace

ment in the ladder compartment. These sets as well as the regular square sets are made from framed round timber.

Drilling in the stopes is done with Ingersoll-Rand wet stopers and Gardner-Denver jackhammers using 1-in. octagon and 7/8-in hexagonal hollow drill steel respectively. Mounted and unmounted G-D jackhammers are used in all drifting operations, except in places where the ground is hard. In such formations a G-D drifter is used. Square-sets used in the stopes measure 7x5x5 ft. The lagging is 2 and 3 in., the size being determined by the character of the ground. All stopes are filled with material sorted out in the stopes proper and waste brought in 19-cu.ft. end-dump cars from prospect drifts and the raises run in the walls of the orebody. Materials and timber are handled by small tugger hoists. Powder consumption is from 0.6 to 0.7 lb. per dry ton of ore mined.

Because of the acidity of the mine water, pumping in short lifts is essential. For this purpose pumps are maintained on the 1,100, 900, 600, and 400 levels. Ventilation is mechanical, low-pressure air generated by a Coppus fan being directed to the underground workings through a main pipe measuring 26 in. in diameter. Air for the drills and tugger hoists is furnished by a G-D 770-cu.ft. compressor driven by a 150-hp. synchronous motor. Minor repairs are made at the combination blacksmith and repair shop, and mine timbers are framed in a small building adjoining the hoist house. Electric power for plant operations is obtained from the Grimes Pass Power Company at the average rate of slightly less than 1c. per kilowatt-hour.

The metallurgy at Gold Hill is relatively simple. About 92 per cent of the values contained in the ore is recovered by amalgamation, as shown in the accompanying flowsheet. Explained briefly, the 10-in. mine-run ore is hoisted to the surface in end-dump cars and dumped into the 100-ton coarse-ore bin near the headframe. From here it is passed over a steel grizzly, with bars spaced 3/4 in., by a pan feeder, the oversize going direct to a 10x20-in. Traylor jaw crusher with 1½-in. opening. Undersize and the crushed product collect in the boot of a bucket elevator discharging into the 145-ton fine-ore bin. The 1½-in. material is then fed to an 8-ft.x22-in. Hardinge ball mill operating in closed circuit with a Hum-mer screen having 0.0215-in. openings (about 35 mesh), over which the ball mill discharge is passed by a bucket elevator. Metallic gold is removed in considerable quantity by the hydraulic trap in the launder leading to the wet elevator sump. Screen oversize returns to the ball mill, and the undersize, after passing three traps, is directed by a distributor to four amalgamation plates. Tailings go by launders equipped with traps to four Wilfley rougher tables for further treatment; and the amalgam scraped from the plates at intervals is stored prior to being sent to the retort. Middlings from the tables flow by gravity to a belt drag classifier, which feeds a Denver Engineering Works 4x3-ft. ball mill. Table tailings and the classifier overflow go to mercury traps before entering the launder leading to the waste dump.

The discharge from the regrind ball mill is pumped by a 1-in. Wilfley sand pump to a rotating distributor feeding two amalgamation plates similar in size and construction to the ones in the primary circuit. Amalgam is sent to the clean-up room, and the tailings, as in the primary circuit, pass through traps to two Wilfley slime tables. Middlings return to the classifier feeding the sands to the regrind mill, and tailings go to the waste dump after treatment in the mercury traps mentioned previously. The material collected in the hydraulic traps and the high-grade cut taken from the two Wilfley slime tables are treated in two mullers, the amalgam going to the clean-up room for treatment in a standard retort and the tailings returning to the classifier in the regrind circuit. The retort product is melted in an oil-fired furnace, and the bars are shipped to the San Francisco Mint. Slag is returned to the regrind mill. Middlings from the concentrating tables are reground to clean the liberated gold and to effect a further separation of fine gold particles.

The ore treated at the mill assays from $6 to $8 per ton and the tailings average 0.019 oz. gold. Total milling cost per ton is 62c. Consumption of quicksilver and steel balls is 0.045 oz. and 2.30 lb. per dry ton respectively. Per cent recovery effected by the different equipment used in the primary and regrind circuits is as follows: Amalgamation plates, 24.2; high-grade cut from the two slime tables, 22.4; hydraulic traps, 38.7; and elevator, 14.7. Over-all operating cost is $4.32 per ton, with stoping expense and exploration standing at $3 per ton and $11.36 per ft. advanced respectively. An average of 115 tons of ore is milled a day at the present time.

A. H. Burroughs, Jr., is president and general manager of Talache Mines, Inc., and J. H. Skidmore is superintendent in charge of operations at Quartzburg.

CATAVI, looking east—a birdseye view. At the left is the mill and beyond it the tailings pile. In the upper right is the "New Colony"

PATIÑO

—Leading Producer of Tin

III . . . Ore Concentration at Catavi

D. C. Deringer . . . and . . . John Payne, Jr.

Mill Superintendent — *Chief Geologist*

Patiño Mines & Enterprises Consolidated, Inc. Llallagua, Bolivia

UNIQUE in its functions and operations, the Patiño milling department not only has the duties of operating a concentrator, but also has a general machine shop, a general carpenter shop, and a foundry under its supervision. All construction at Catavi, which at certain periods reaches rather large proportions, is handled by this department. General repairs to the camp are maintained by the mechanical department of the mill, as is the water supply. Fabrication of emergency items consumes a large part of the time in the shops because of the distance of the property from supply sources.

Ore is hauled in 30-ton hopper-bottom railroad cars 3½ km. from Siglo XX sorting plant to the mill, being first weighed on railroad scales at Siglo XX and again at Catavi as a check. The cars are dumped directly into a 2,500-ton mill bin. As received the ore has all passed a 1½x3-in. punched-plate trommel. From the bin, eight feeders deliver the ore onto two 30-in. inclined conveyors, which in turn discharge into four 16-mm. trommels. Oversize is conveyed by an inclined cross conveyor back to two sets of 57x20-in. Traylor rolls. The crushed product falls onto the same belt carrying the original feed, and again passes through the trommels. Undersize goes via a 24-in. conveyor over two 6-mm. Leahy screens, and the undersize from the latter is conveyed directly to a 3,000-ton fine-ore bin. The oversize passes to a 200-ton bin ahead of the secondary crushing plant. It is plus 6-mm. in size and is crushed by two sets of 42x16-in. Allis-Chalmers rolls

THE CATAVI MILL, seen from a nearer point. The sorting plant at Siglo XX, from which the tin ore is delivered to the concentrator, is 3½ km. distant

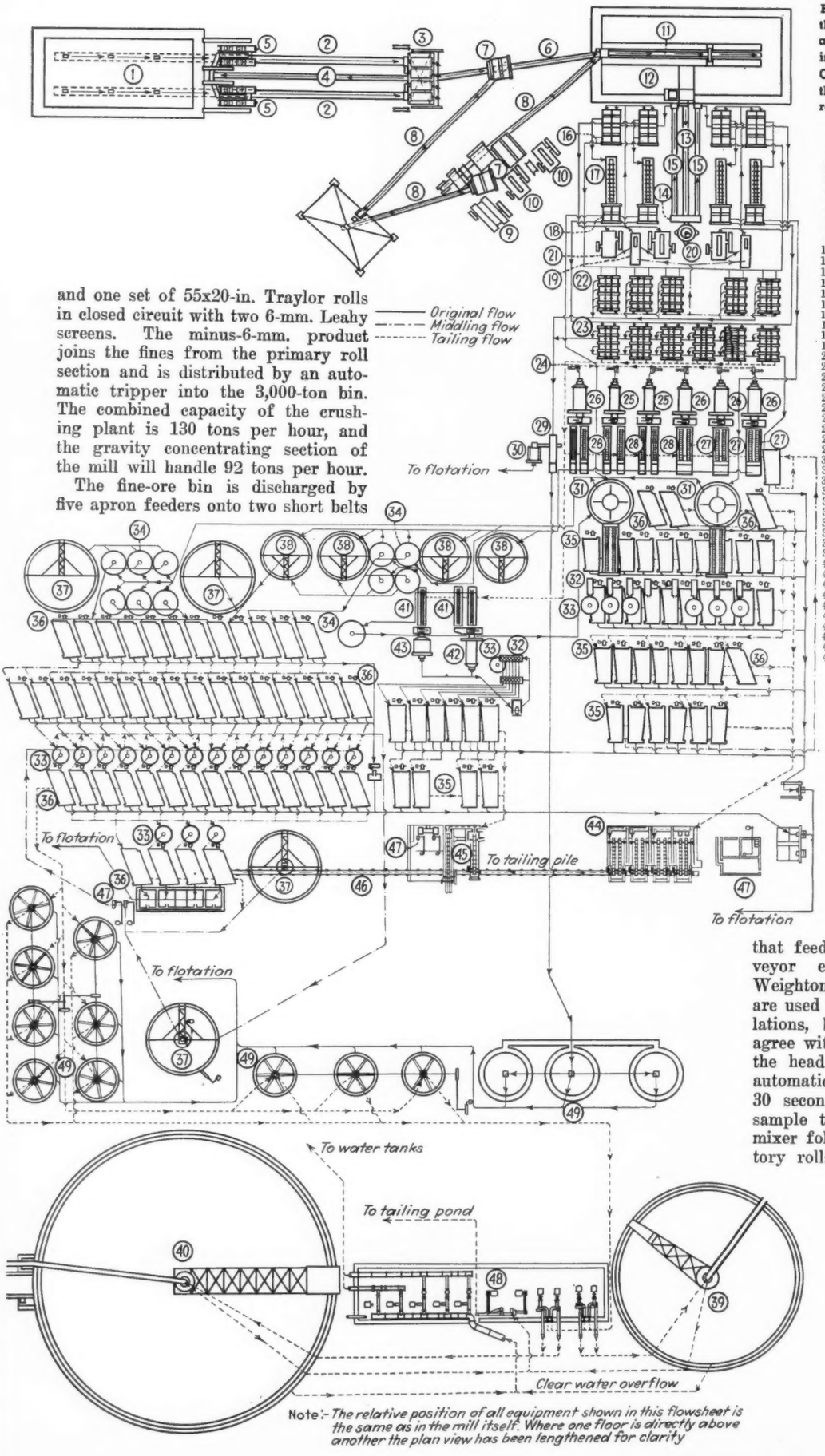


Fig. 11 . . . CONCENTRATION of the tin ore at Catavi proceeds according to this flowsheet. Tabling is an important part of the work. Close sizing of the table feed is the secret here of obtaining high recoveries and producing high-grade concentrates

LEGEND

1. 1 Receiving ore bin
2. 2 30-in. belt conveyors
3. 4 4x10-ft. trommels
4. 1 24-in. return conveyor
5. 2 57x20-in. roll crushers
6. 1 24-in. belt conveyor
7. 20 6-mm. vibrating screens
8. 3 20-in. belt conveyors
9. 1 55x20-in. roll crusher
10. 2 43x16-in. roll crushers
11. 1 Tripping conveyor
12. 1 Fine-ore bin
13. 1 Mill-head conveyor
14. 1 Main bucket sampler
15. 2 Mill head conveyors
16. 16 3-mm. vibrating screens
17. 4 Drag classifiers
18. 8 1-mm. vibrating screens
19. 2 Bucket elevators
20. 1 Disk sampler
21. 3 43x16-in. roll crushers
22. 5 Coarse jigs
23. 6 Fine jigs
24. 6 Wilfley pumps
25. 2 4x10-ft. rod mills
26. 4 5x10-ft. rod mills
27. 3 6-ft. Dorr classifiers
28. 6 3-ft. Dorr classifiers
29. 1 3-ft. drag classifier for concentrates
30. 1 Belt conveyor and bin
31. 2 16-ft. bowl classifiers
32. 10 Fahrenwald classifiers
33. 24 6-ft. Fahrenwald cones
34. 11 8-ft. Fahrenwald cones
35. 45 Plat-O tables
36. 55 Deister-Overstrom tables
37. 4 30-ft. thickeners
38. 4 20-ft. thickeners
39. 1 75-ft. thickener
40. 1 120-ft. thickener
41. 3 Dorr classifiers
42. 1 4x10-ft. rod mill
43. 1 6x6-ft. ball mill
44. 4 01C drag classifiers
45. 2 3-ft. drag classifiers
46. 1 Belt conveyor
47. 5 Wilfley pumps
48. 1 Pump house
49. 13 Buddles

and one set of 55x20-in. Traylor rolls in closed circuit with two 6-mm. Leahy screens. The minus-6-mm. product joins the fines from the primary roll section and is distributed by an automatic tripper into the 3,000-ton bin. The combined capacity of the crushing plant is 130 tons per hour, and the gravity concentrating section of the mill will handle 92 tons per hour.

The fine-ore bin is discharged by five apron feeders onto two short belts that feed onto a 20-in. inclined conveyor equipped with a Merrick Weightometer. Weights as indicated are used for daily metallurgical calculations, but are finally corrected to agree with those of the railroad. At the head of the 20-in. conveyor, an automatic sampler cuts a sample every 30 seconds, which passes through a sample tower consisting of a barrel mixer followed by two sets of laboratory rolls in series, and finally onto

Note:- *The relative position of all equipment shown in this flowsheet is the same as in the mill itself. Where one floor is directly above another the plan view has been lengthened for clarity*

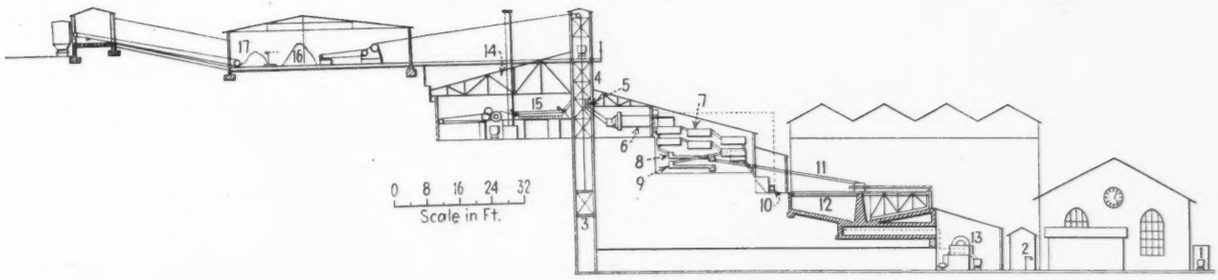


Fig. 12 . . . FLOTATION is used at the Catavi mill to remove sulphides from the gravity concentrates, thereby to avoid smelter penalties on excess sulphur and base metals and to lessen the cost of freight and treatment per ton of tin contained. The flowsheet of the flotation plant and the arrangement of the latter are shown here

LEGEND

1. Concentrates from Gravity Mill
2. 1 Scales
3. Hoist and cage
4. 1 Bin for flotation heads
5. 1 Apron feeder
6. 1 5x10 ft. rod mill
7. 8 MacIntosh flotation cells
8. 1 Pilot table for sulphides
9. 1 Pilot table for concentrates
10. 4 Return pumps
11. 1 Concentrate launder to thickener
12. 1 50-ft. thickener
13. 1 Oliver filter
14. 3 Bins ahead of dryers
15. 3 Lowden dryers
16. Dry tin concentrate in warehouse
17. Sacked tin concentrate to railroad

a Sullivan disk sampler, where four final samples are taken. The mine gets one sample and the mill three samples. Over a month the four samples will check within 0.05 per cent Sn, which is well inside the limits of tolerance for assaying and sampling. Moisture samples are taken from each trainload of ore as it leaves the mine sorting plant and again as the ore is being discharged into the mill bins at Catavi. These two moisture samples must, and usually do, check closely. Thus the mine has at all times a complete check on weights and assays of the mill feed. It has the privilege of challenging at any time the figures reported by the mill.

After passing the sampler mentioned the ore is split into two parts, each going by a 16-in. conveyor to two banks of four Leahy screens with 3-mm. Ton-Cap screen. Water is added for the first time on these screens. Oversize is sent by launder to six double-compartment cup-discharge jigs, which make a concentrate for flotation and a tailing that is elevated to two banks of four Leahy 3-mm. screens. These screens are in closed circuit with three sets of 42x16-in. Allis-Chalmers rolls, the crushed product joining the jig tailings in the elevator boot. The minus-3-mm. jig tailings join the minus-3-mm. product from the original feed, and go to two dewatering drag classifiers, and thence to two banks of four Leahy screens equipped with 1-mm. screen. Oversize from the latter, which is minus 3-mm. plus 1-mm., is laundered to six double four-compartment, hutch-discharge jigs, which deliver a concentrate for flotation from the first two spigots and one containing considerable pyrite from the third and fourth. This heavy pyrite concentrate is tabled on the floor below to clean out some of the silica included with the pyrite. The jig tailings are dewatered in six duplex Dorr classifiers, which discharge their sand into the scoop boxes of four 5x10-ft. and two 4x10-ft. Allis-Chalmers rod mills. These six mills being insufficient to handle the grinding load, a portion of the fine jig tailings is bypassed to two grinding mills in the slime section. These are on the lower floor of the mill, and, with the tables serving them, constitute a separate concentrating unit.

All rod-mill grinding is in open circuit and is done wet to prevent oversliming. Discharge from the rod mills is laundered to four 4-in. Wilfley pumps that elevate the pulp to the launders carrying minus-1-mm. product from the previously mentioned screens to two 16-ft. bowl classifiers, which separate the 200-mesh slimes from the sands.

The sand from the bowl classifiers is laundered to eight (modified) Fahrenwald classifiers, where seven products are made, having the approximate screen analysis given in Table XI. The overflows from the cones of the Fahrenwald classifiers and bowl classifiers are combined to form the feed of the slime section. This is 80 per cent minus-240 mesh.

Table XI—Screen Analysis of Product of Fahrenwald Classifiers

Product	Mesh	
Spigot No. 1	+ 28	
Spigot No. 2	− 28	+ 35
Spigot No. 3	− 35	+ 48
Spigot No. 4	− 48	+ 65
Spigot No. 5	− 65	+100
Spigot No. 6	−100	+150
Cone underflow	−150	+200

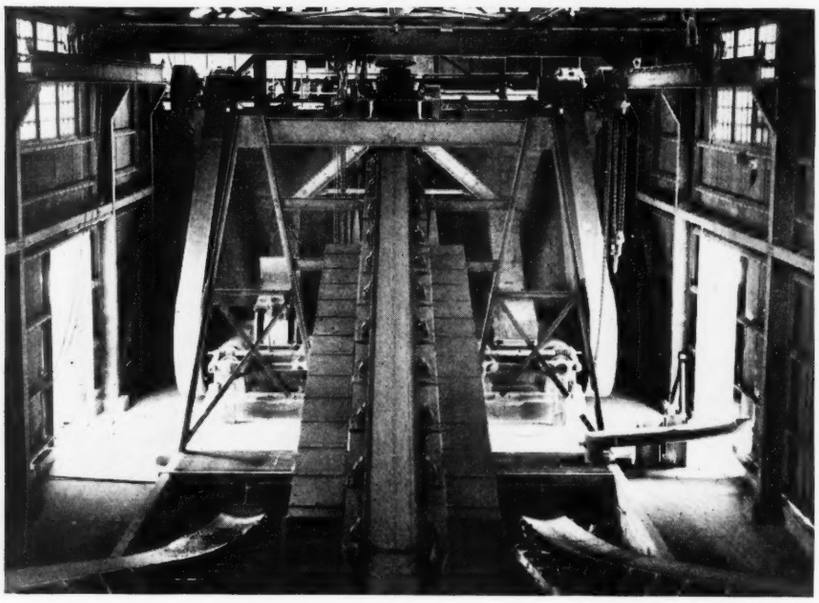
Twenty-eight tables handle the seven sand products on the first tabling. Tables treating the first spigot product make a concentrate for flotation and a tailing that is reground in the six rod mills previously mentioned. The second spigot product is tabled to make a concentrate for flotation, a middling for re-tabling, a second middling which is sent back for re-grind, and a waste tailing. All other tables on the first table floor make a concentrate for flotation, a table middling that is re-tabled, and a final tailing which goes to waste. The middling is laundered to additional tables that in turn make a final tailing, a concentrate for flotation, and a middling. This second middling is re-tabled and a concentrate produced from it.

All tailings are sufficiently high in tin to warrant returning them to the head of the table section. Close sizing of table feed is the secret of obtaining high recoveries and high-grade concentrates in tin milling. Tabling and re-tabling of each sized Fahrenwald classifier product is kept separate from all other sizes throughout the several tabling operations. Each size of product requires a slightly different type or depth of riffle. All sands coarser than 80 mesh are treated on Plat-O tables equipped with the more or less standard Wilfley riffles, whereas all products smaller than 80 mesh are treated on the Deister-Overstrom diagonal-deck table.

To date, all tables have been decked with battleship linoleum and oak riffles. Through the co-operation of the Hewitt Rubber Company, rubber decks and riffles are now being tested, as against former practice. Although these tests have not been in progress long enough to permit exact statements as to the merit of rubber riffles and decks, the continuance of their use seems advantageous.

Overflow from the Dorr bowl classifiers, which separate sands and slimes, is laundered to cone classifiers, where a separation of plus- and minus-400 mesh is made. The cone overflow is thickened in Dorr thickeners. The thickened pulp and the cone underflow are kept separate during tabling. This is another example of classifying even a minus-150- or -200-mesh product prior to tabling.

Four floors of Deister-Overstrom slime tables, totaling 52, treat the two slime products to which reference was just made. The slime section handles approximately 50 to 55 per cent of the total tailing tonnage, with sand section tailings representing the remainder. The tables on the first floor, sixteen in number, make a concentrate for flotation and a tailing. This tailing is again tabled, giving a concentrate for flotation, a middling that is subsequently re-tabled, and a final



COARSE CRUSHING is done in this plant at the Catavi concentrator. The ore, having previously passed a 1½x3-in. punched-plate trommel, is sent through four trommels having 16-mm. screens, the oversize going to 57x20-in. Traylor rolls, seen here with the cross conveyors

tailing which goes to waste. The Middlings from the second tabling operation go to a series of dewatering cones, the overflow of which is thickened in 50-ft. thickeners and joins the cone underflow.

The third floor of tables receiving the thickened pulp makes a concentrate, a middling for re-tabling, and a final tailing to waste. The middling produced from the third floor of tables is re-tabled on four tables, producing a concentrate, but the tailings are sufficiently high in tin to be returned to the head of the third floor of tables.

All tailings made in the slime section are laundered to the buddles section. These buddles are of the center-discharge type and function as policemen rather than as concentrating units. Their contribution to the over-all recovery is small, as may be seen in the data on operation.

Sand tailing is dewatered in four large drag classifiers of the Esperanza type. These discharge onto a 16-in. conveyor belt that carries the sands to a 500-ton tailing bin. An aërial tram takes the sands from the bin and automatically stacks them along a 2-km. line. Slime tailings are thickened in one 120-ft. and one 75-ft. thickener. The thickened slimes are pumped by an 8-in. Wilfley pump and deposited on the up-hill side of the sand tailing pile made by the aërial tramway. Clear water overflow is pumped back to the mill-head tanks.

All gravity concentrates, after being thoroughly mixed in a *patio*, are sent to flotation. The object is to remove sulphides from the gravity concentrates; first, to avoid heavy smelter penalties on excess sulphur and base metals, and, second, to raise the grade of concentrates to lessen the cost of freight and treatment per ton of tin contained. It is the duty of the flotation section to keep sulphur below penalty and the grade above 60 per cent tin. Naturally, the gravity section must deliver concentrates sufficiently low in silica to allow the flotation to function properly. Since early in 1935, thanks to changes in flotation reagents, practically no penalties have been paid on sulphur or base metals.

After passing flotation, the cleaned tin concentrates are thickened in a 50-ft. thickener, whereas the sulphide froth containing most of the impurities is pumped to the tailing dam. The thickened concentrate is dewatered in a 6-ft. Oliver filter and subsequently passes over Lowden driers, where the moisture content is reduced to below 0.80 per cent H_2O. From the driers, the concentrate passes to the concentrate warehouse, is weighed, sacked, and divided into 24-ton lots. Every sack in the lot is stenciled with a "lot" number and is then ready for export.

Prior to 1930, flotation handled only a relatively high-grade gravity concentrate which was much lower in sulphur than that floated today. The major part of the sulphides went into a middling that was subsqeuently roasted in Kauffman roasters and re-tabled. This was made necessary because excessive amounts of sulphur

Table XII—Milling Results in Gravity Section

	Ore Milled			Concentrates Produced		Assay Tailings,	Actual Recovery
Year	Dry Tons	% Sn	Tons Sn	% Sn	Tons Sn	% Sn	%
1926	232,775	5.67	13,189.4	49.40	9,815.45	1.12	74.42
1927	299,858	4.97	14,916.1	54.28	11,415,65	1.02	76.53
1928	481,028	4.64	22,342.4	51.91	17,404.06	1.00	77.90
1929	703,592	3.94	27,690.4	49.71	21,422.21	0.84	77.36
1930	565,607	3.96	22,380.1	47.13	17,623.31	0.80	78.75
1931	432,343	4.20	18,167.4	46.16	14,690.36	0.79	80.86
1932	248,485	3.85	9,569.0	42.57	7,709.45	0.69	80.57
1933	141,141	3.84	5,421.1	44.15	4,371.89	0.73	80.65
1934	179,612	3.86	6,939.0	46.81	5,637.09	0.72	81.24
1935	275,996	3.76	10,380.8	45.69	8,475.25	0.70	81.64

Table XIII—Elutriation Analysis of Final Slime Tailing

Product	Diameter in Mm.	Mesh	% Weight	% Weight Cumulative	% Sn	% Sn Distribution	Cumulat % Sn Distribution
Cone 1	0.183	70	21.79	21.79	0.43	11.12	11.12
Cone 2	0.083	180	26.92	48.71	0.37	11.82	22.94
Cone 3	0.034	560	22.44	71.15	1.31	34.89	57.83
Overflow	0.005	2,280	28.21	99.36	1.26	42.17	100.00

Table XIV—Screen Analysis of Final Sand Tailing

Mesh	% Weight	% Weight Cumulative	% Sn	% Sn Distribution	Cumulative % Sn Distribution
10	0.79	0.79	0.70	1.23	1.23
14	3.02	3.81	0.62	4.18	5.41
20	6.83	10.64	0.42	6.41	11.82
28	16.35	26.99	0.37	13.52	25.34
35	20.48	47.47	0.42	19.21	44.55
48	17.78	65.25	0.40	15.88	60.43
65	10.79	76.04	0.47	11.33	71.76
100	15.73	91.77	0.47	16.51	88.27
150	4.29	96.06	0.50	4.78	93.05
200	2.54	98.60	0.70	3.98	97.03
−200	0.95	99.55	1.40	2.97	100.00

Table XV—Catavi Mill Tailings Assays

Year	Sand Tailing, % Sn	Slime Tailing, % Sn	Average Tailing, Slime and Sand, % Sn	Flotation Froth, % Sn
1926	0.81	1.51	1.12	3.73
1927	0.87	1.44	1.02	2.58
1928	0.81	1.29	1.00	1.82
1929	0.68	1.07	0.84	1.87
1930	0.62	0.96	0.80	1.68
1931	0.55	1.02	0.79	1.15
1932	0.47	0.92	0.69	1.13
1933	0.45	0.99	0.73	1.05
1934	0.43	0.91	0.72	1.17
1935	0.43	0.91	0.70	0 85

could not be handled in the flotation section. Although the average grade of tin concentrate thus produced was approximately the same grade as is made today, sulphur was high and recoveries were lower.

Table XII summarizes the milling results in the gravity section during the past ten years. Tables XII, XIII, XIV, and XV appear on the preceding page, 302.

Although the head assay has gradually dropped during the past ten years, the recovery has advanced. Gradual training of native foremen and personnel has contributed to the advance in recoveries, as has the betterment of flowsheet to suit the particular type of ore being treated. In the past two years, advance in recovery is due to flotation having lowered the sulphur content of the final concentrate, which in turn allowed more silica to be cut into the gravity concentrate. From a careful study of tailing products of the mill, it appears that recoveries are now about the highest that can be expected for the type of ore now being treated.

A typical example of an elutriation analysis of our final slime tailing (discharge from buddles) is given in Table XIII. From the figures it will be seen that 77.06 per cent of the tin losses in the final slime tailing is in the 0.034-mm. (560-mesh) range or finer.

A typical screen analysis of our final sand tailing is given in Table XIV.

Table XV gives the assay of various final tailings produced in the Catavi mill during the past ten years. The calculated tailing, by difference, within the last two or three years has been approaching more closely that of the assayed tailing, as indicated by actual recovery as shown in Table XII.

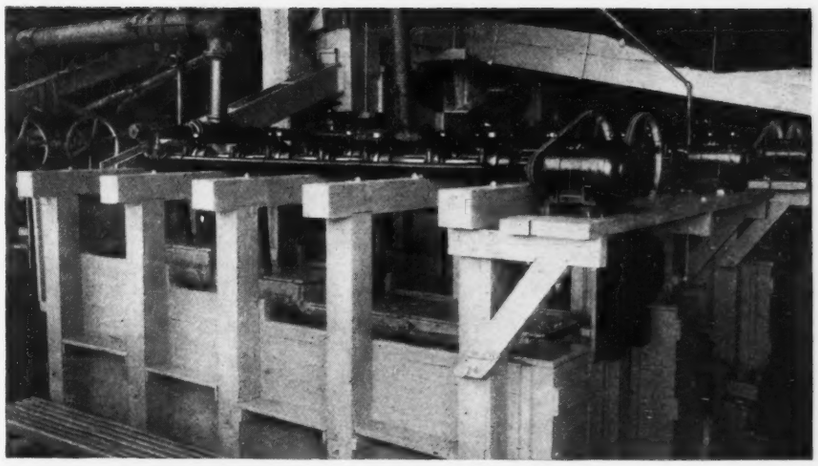
An interesting table is No. XVI, which shows the contribution to the total recovery of the various sections of the gravity mill. It is shown below, to the right.

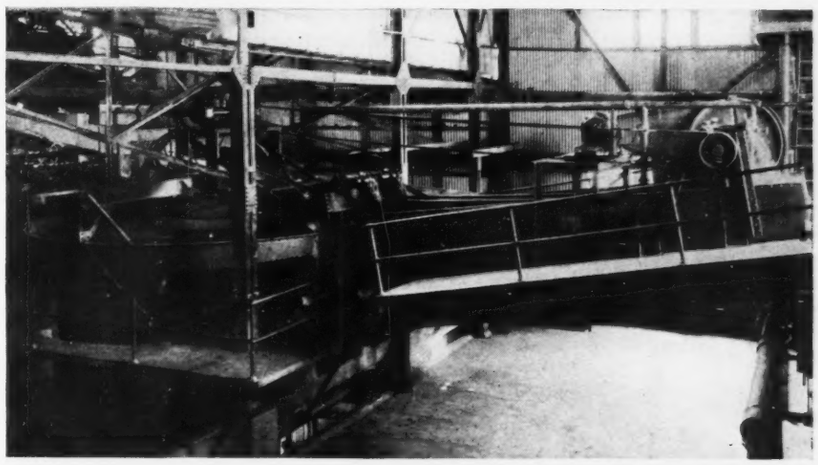
During the past ten years, crystallization of the cassiterite in the mill feed has gradually become finer, which accounts for the drop in contribution to the total recovery of the jigs and the increase in contribution from the table section.

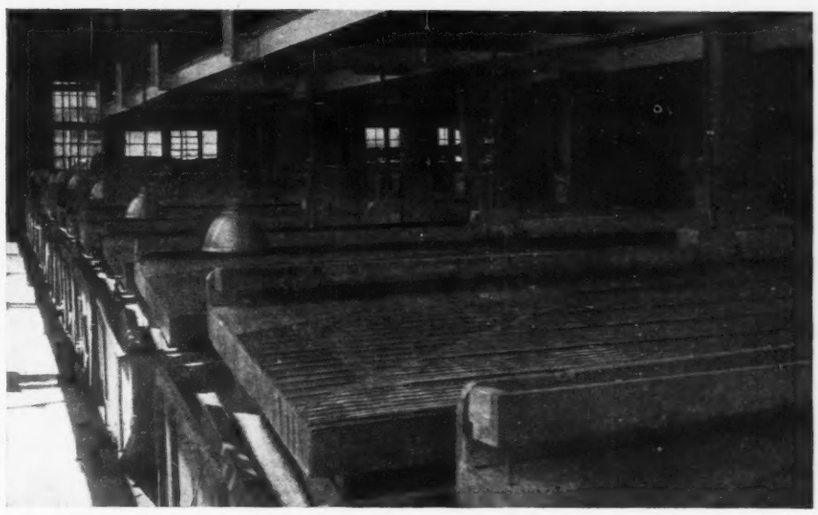
The flotation section of the mill uses the gravity concentrate as its heads. The results of this section are given in Table XVII. (Page 304.)

A complete analysis of the tin concentrate after flotation, ready for export, is given in Table XVIII.

Dumps—The company has on dumps over 1,000,000 tons of material formerly discarded from sorting the richer ore of earlier mining operations. From August, 1936, this dump material, after being sorted, was treated



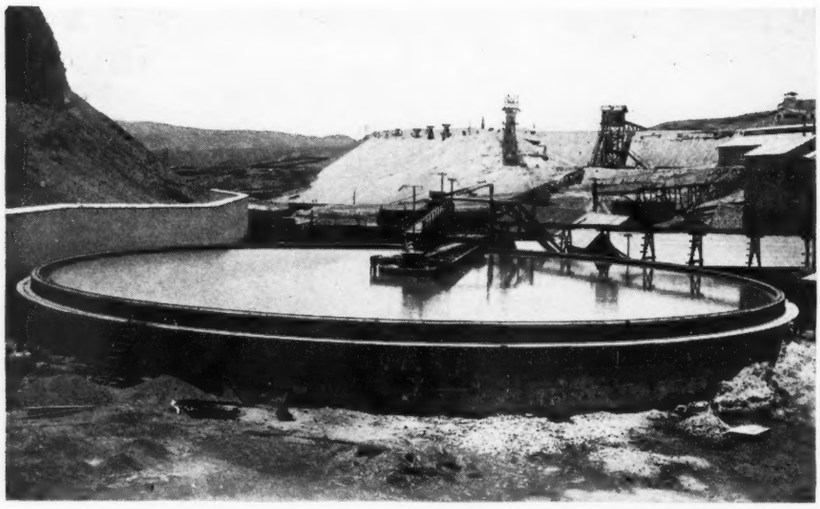




INSIDE THE CATAVI MILL.—Some glimpses of the equipment: 1. In the jig section. 2. Bowl classifiers. 3. The first floor of the sand table section

Table XVI—Per Cent Recovery in Gravity Mill

Year	Jigs	Sand Tables	Slime Tables	Buddles	Total Recover
1926	44.24	9.15	5.00	0.73	74.42
1927	43.48	10.14	6.98	0.75	76.52
1928	33.03	25.61	7.50	0.66	77.90
1929	22.70	33.91	9.07	0.50	77.36
1930	24.15	37.90	9.58	0.44	78.75
1931	22.25	46.36	7.59	0.44	80.86
1932	17.53	55.17	7.13	0.52	80.57
1933	20.49	52.35	7.04	0.77	80.65
1934	19.79	53.61	7.16	0.68	81.24
1935	18.52	54.81	7.75	0.55	81.64



THIS THICKENER, 120 ft. in diameter, with another unit of 75-ft. diameter, handles the slime tailings. Behind it is seen the pile of sand tailings 2 km. long, built up by an aërial tramway. The thickened slime tailings are delivered by pump to the up-hill side of the sand tailings pile

IN THE BARRILLA BODEGA. Here the barrilla, or tin concentrates, is sacked, weighed, and divided into 24-ton lots for shipment over the company's railway to the main line at Machacamarca

Table XVII—Results in Flotation Section, Catavi Mill

Year	Tons Gravity Concentrate Floated	% Sn	Concentrates Produced: Tons of Concentrate	% Sn	Tons Sn in Concentrate	Recovery % in Flotation	% Over All
1926.....	11,584.56	39.30	7,244.50	60.61	4,391.21	96.44	70.72
1927.....	17,349.70	52.32	13,834.90	64.95	8,986.00	99.00	75.88
1928.....	29,410.70	50.15	22,622.90	64.65	14,626.59	99.16	77.39
1929.....	39,510.10	48.46	29,733.10	63.78	18,963.81	99.05	76.69
1930.....	35,087.60	46.15	25,080.00	63.89	16,024.12	98.96	77.56
1931.....	30,560.70	45.03	21,474.60	63.60	13,657.42	99.24	80.35
1932.....	18,187.10	42.76	12,112.70	63.63	7,707.37	99.12	79.82
1933.....	9,901.60	44.40	6,692.40	65.19	4,362.76	99.23	80.04
1934.....	12,045.00	46.81	8,704.80	64.31	5,598.09	99.31	80.74
1935.....	18,547.30	45.69	13,031.20	64.68	8,428.08	99.44	81.20

This table shows only the concentrates passed through flotation. Prior to 1933 a portion of the export or finished concentrate was produced in the calcine section, and consequently this table does not constitute total production for export. After 1933, flotation production equals export production.

Table XVIII—Analysis of Tin Concentrate After Flotation

Year	Percentages: Bi	Fe	Cu	Pb	Zn	S	As	Sb	WO_3	Al_2O_3	SiO_2	TiO_2	P
1926.....	0.69	7.19	0.13	0.12	0.26	6.03	0.64	0.11	0.69	0.11	5.36	....	0.30
1927.....	0.54	4.18	0.26	0.18	0.20	3.35	0.20	0.24	0.63	1.55	5.91	0.32	0.33
1928.....	0.43	3.97	0.17	0.17	0.13	3.52	0.19	0.06	1.18	2.22	4.69	0.19	0.18
1929.....	0.31	4.08	0.17	0.19	0.27	3.39	0.13	....	1.00	2.40	5.39	0.17	0.16
1930.....	0.33	3.61	....	0.17	0.23	3.12	0.10	0.10	0.87	1.76	5.37	0.32	0.13
1931.....	0.27	4.59	0.10	0.12	0.24	2.88	0.10	0.10	0.79	1.37	5.57	0.14	0.10
1932.....	0.23	4.63	0.10	0.09	0.24	2.38	0.10	0.10	0.77	1.91	5.71	0.25	0.10
1933.....	0.19	4.98	0.10	0.09	0.21	2.22	0.10	0.10	0.64	1.84	5.28	0.12	0.10
1934.....	0.19	4.58	0.05	0.12	0.21	2.34	0.10	0.02	0.75	2.07	5.89	0.17	0.10
1935.....	0.20	3.95	0.05	0.15	0.17	1.72	0.09	....	0.56	2.42	....	1.12	0.09

in the mill at Catavi, alternating every other week with mine ore. The dumps are scattered on both sides of Llallagua mountain. On the average the material assays approximately 1.0 per cent Sn. By sorting it is brought up to 1.4 per cent Sn. The treatment has proved successful, both from a metallurgical and economic viewpoint, because of the low costs of handling and collection. On a mill feed of 1.4 per cent Sn, the mill has been making an actual recovery of 72 per cent, and with a grade of concentrate better than 63 per cent Sn.

To date, most of the ore from dumps has come from two dumps nearest the Siglo XX sorting plant, but there are now under construction temporary sorting plants that will render the many other dumps available for milling. In September, 1936, 193 tons of fine tin were made from this type of ore, and it is anticipated that this production will be increased in the near future.

The Metallurgical Department—The metallurgical laboratory, under the supervision of a metallurgist, is equipped to make flotation, cyanide, classification, elutriation, and table tests, microscopic analysis, and continuous mill tests. The equipment consists of the following:

1 Complete Denver continuous-flow pilot mill, with tables, classifiers, and flotation. Capacity 250 lb. per hour
1 Denver Sub A 2,000-gram flotation machine
1 Denver laboratory coarse and fine table
1 General Engineering hydraulic classifier
1 General Engineering laboratory jig
1 Wysor grinding and polishing machine
1 Leitz metallographic microscope (750 dia.) with special attachments for thin-section work
1 Leitz binoculars
1 Tyler Ro-Tap sizer

A sample preparation room is provided, equipped with a crusher, rolls, pulverizer, and a Westinghouse 10-kw. electric oven for drying samples. The metallurgist has charge of all mill sampling and keeps a daily check on mill performance and tin. At times considerable laboratory test work has to be done on material from other properties the company has under option or is examining with the idea of purchase.

Costs—Until the last quarter of 1936, all costs were reported in bolivianos, and because of the inflation through which Bolivia is passing, they are difficult to analyze. About all that can be said at this time is that the total costs for milling is about $1.35 United States currency per ton of ore, distributed as follows: Labor, $0.40; material, $0.50; and power, $0.45. The power consumption is 20 kw. per ton milled.

Economics of Tin Concentration—A tin smelter schedule is complicated, but in general it may be summarized as follows: Full payment for all tin contained in the concentrates at market price, with a base treatment charge per ton and an additional charge for

each pound sterling above £200 market; a premium or penalty for each per cent above or below 60 per cent tin concentrates. In addition, there are penalties for each 0.10 per cent of combined base metals above 0.50 per cent and a penalty for each 0.10 per cent of sulphur above 1.75 per cent sulphur in the concentrates. There is also a heavy Bolivian export tax, which constitutes the major part of the government revenue. Freight rates to the seaboard are high. The total of these expenses for treatment, freight, taxes, and marketing, per ton of fine tin contained in a 60 per cent tin concentrate, is approximately £60. It is the duty of the milling department to balance recovery and grade of concentrates, so as to make the highest monetary recovery possible. The curve in Fig. 13 shows the net smelter return per ton of concentrates of various grades and the net smelter return per ton of fine tin contained in these various grades of concentrates.

In Fig. 14, the curve gives the relationship between grade of concentrate and recovery. All points on the curve will give the same net smelter return per ton of concentrate when the market price of tin is £225 per ton and when treating a 4 per cent Sn head. If a concentrate ranging between 62 and 64 per cent Sn is being made, 0.40 per cent in recovery can be sacrificed to raise the grade 1 per cent on a 4 per cent Sn head. When the market price of tin is £200 per ton, the optimum grade of concentrate is about 65 per cent Sn on our ores. When a higher grade is attempted, the recovery falls off faster than 0.40 per cent per per cent raise in grade, whereas the contrary is true when making a concentrate of less than 65 per cent Sn. An added recovery of 0.10 per cent, other factors remaining constant, adds about $7,000 per year to the company's net income.

Future Possibilities — The fundamentals of cassiterite concentration have advanced little in the past twenty years, because no other method has succeeded except gravity methods. Some work has been done in various countries on cassiterite flotation, but nothing of commercial importance has developed from this research. Tin oxide is very insoluble in any known aqueous solution, and consequently there are no Sn ions released to act with modern flotation reagents. Metallic salts will not reactivate cassiterite. The fatty acids show some tendency to float it ahead of gangue minerals, but to date the selectivity is insufficient to make a satisfactory flotation.

There appears to be very little selection between iron oxide or iron-stained gangue minerals and cassiterite. The index of floatability for iron-stained quartz and for cassiterite is approximately equal. In spite of the failure of the past, the future will probably find some reagent that has either a selective absorption or selective ionization of the tin in cassiterite, in which case flotation will be successful.

Hydrometallurgy has not found a commercial solvent for cassiterite, but again there is probably a metallic salt combination awaiting discovery that will give a successful process. We know little about the solvent power of various combinations of metallic salts in aqueous solutions on natural mineral.

Because tin mineralization occurs in relatively few localities, extensive research on its metallurgy has been correspondingly localized. The metal affords one of the most interesting research problems unsolved today, and it is strange that more institutions of learning have not attempted to find a solution, if only for the love of research. There are millions of tons of dump materials in Bolivia containing 0.75 per cent Sn. When it is remembered that at least one of the largest copper companies is treating copper ores of a grade only a little higher, and that copper has only about one-fifth the market value of tin, some of the economic possibilities awaiting an improved metallurgy of cassiterite are apparent.

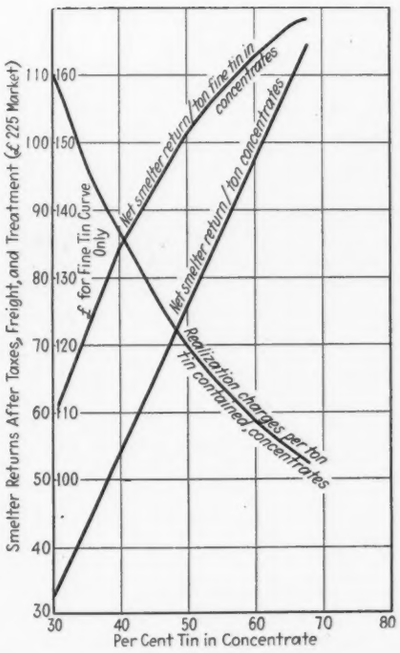

Smelter Returns After Taxes, Freight, and Treatment (£ 225 Market)
£ for Fine Tin Curve Only
Net smelter return / ton fine tin in concentrates
Net smelter return / ton concentrates
Realization charges per ton fine tin contained, concentrates
Per Cent Tin in Concentrate

Fig. 13 . . . NET SMELTER RETURN per ton of tin concentrates of various grades is shown on this graph; likewise the return per ton of fine tin in the concentrates, and the realization charges per ton of tin contained

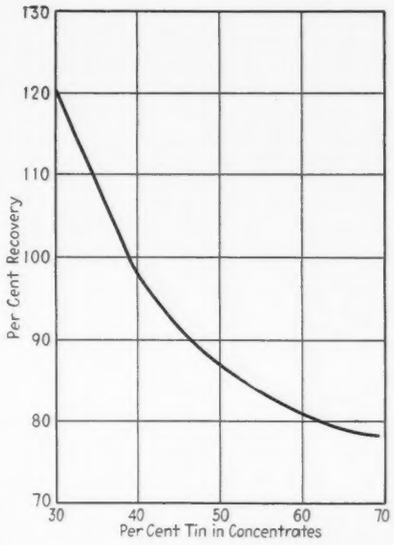


Fig. 14 . . . RELATIONSHIP between grade of concentrates and recovery is given by this curve. All points will give the same net smelter return per ton of concentrate when tin commands £ 225 per ton on the market and when treating a 4 per cent tin head

Machine Shop—The general machine shop at Catavi is equipped with five lathes, a large and small radial drill press, heavy-duty shears, metal rolls, pipe- and bolt-threading machines, a shaper, a milling machine, and a 200-ton hydraulic press. Work of special character, such as gear cutting, turning heavy castings, and machining of foundry castings, is done here. There is also a smaller shop that does the routine repair work and small construction jobs for the mill. A machine shop, modern in every respect, is now being built that will, when completed, centralize all mechanical work. This shop is equipped with an all-electric 10-ton crane to service heavy machines.

The 200-ton hydraulic press is principally used to press crushing-roll shells on the core under 60 to 120 tons' pressure. Roll shells are an expensive item in milling costs, and by pressing shells on the core, they can be worn down to an average thickness of ½ in. It is not uncommon to have a shell wear to ¼ in. before becoming loose. Rubbing bricks fastened to the roll housing keep the faces in alignment and free from channeling.

Foundry—The foundry is equipped with a 2-ton and a 1-ton cast-iron cupola and four forges where 250-lb. capacity graphite crucibles are heated for brass casting. The greater part of the castings are pulleys, turntables for cars, and wearing parts for sand pumps. A large amount of emergency fabrication is necessary for both mine and mill because of the time required to secure replacements. Within the past year, molybdenum chromium has been used as a harden-

ing agent for white iron, and it has been found to lengthen the life of pump runners and casings materially. We expect to cast rod mill liners in the near future for a trial against imported manganese steel.

The foundry casts an average of 15 tons of cast iron and 4 tons of brass castings per month. All iron used in the foundry is taken from old scrap recovered locally from worn-out and obsolete machinery.

Carpenter Shop — The carpenter shop is equipped with three planers, two circular saws, a mortise machine, two hand power saws, and a wood lathe. All finished woodwork, such as doors, windows, and furniture, is made locally from rough sawed lumber imported from the United States and Chile. During periods of heavy construction the demands on the carpenter shop are extensive. This shop has a department that upholsters overstuffed furniture, so that the only material imported for making furniture is rough lumber, cloth, and springs. Manufacture and repairing of concentrating tables, decks, and launders is a big item in the carpenter shop.

Construction Work—An engineer designs and estimates the cost of all proposed new construction, and subsequently sees that the actual construction follows the accepted plan. When a new project involves large expenditures for labor, the job is divided into several small assignments and native workmen are given contracts on each assignment. It has been found that less supervision is required and more rapid and better work is done when construction is thus placed in small contracts. When large contracts are given native foremen, the results are always disappointing, due to the inability of the native workmen to handle large gangs of men.

The Catavi theater, to be fully described in a later issue, was constructed by this department. A colony for Bolivian office employees, consisting of 40 duplex, four-room houses, is now under construction. These houses are of modern design and equipment. An average of three staff houses are renovated each year, keeping them in excellent repair and completely modern in every respect.

A new machine shop, previously mentioned, is now being built. This shop is 65x150 ft., of masonry construction, with steel crane columns and trusses. During the past two years, the construction department of the mill has employed about 200 men.

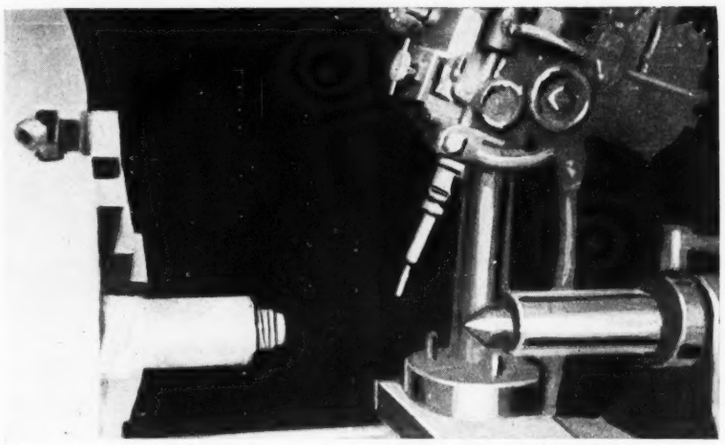
Between 800 and 1,500 tons of lime and 50,000 to 75,000 brick are burned per year at Catavi, the major part of which is used on construction jobs. Approximately 75,000 adobe bricks are consumed here annually.

(To be concluded)

Building Up Worn Machine Parts

ONE piece of equipment that has materially lowered maintenance costs by speeding up repairs on worn locomotive, hoist, cage, and numerous other mining machinery parts at the machine shop of Anaconda Copper Mining Company, Butte, Mont., is a small, automatic electric welding machine. Machine parts particularly subject to rapid wear are the wheels of electric locomotives, roller supports for skips and cages and shafts on a multitude of machines used around the plant. In many cases the worn parts are simply scrapped, but at shops where an electric welding machine is available the worn surfaces are built up by welding, followed by machining in the lathe or planer. However, the latter method is a time-consuming and tedious task when welding is done by hand, and frequently the cost of repairing the part may exceed that of a new unit.

The building up of worn shafts and locomotive wheels in the Anaconda shop is done quickly and efficiently by the automatic welding machine shown in the accompanying illustration. As will be seen, it is mounted on an adjustable cross-arm of the steel support secured to the cross-slide of the lathe set aside for the work explained previously. Depending on the shape of the unit to be built up, it can be held either between the live and dead centers of the lathe or be secured to the face plate or chuck of the lathe. After the welding rod has been adjusted, the lathe and welding machine are started simultaneously and kept in operation until the first layer of metal has been deposited.



Automatic welding machine on steel post secured to cross-slide of lathe, building up the roller support of the ore skip in the lathe on the left

The operation differs very slightly from conventional lathe work, except that the cutting tool is replaced by the electrode of the welding machine.

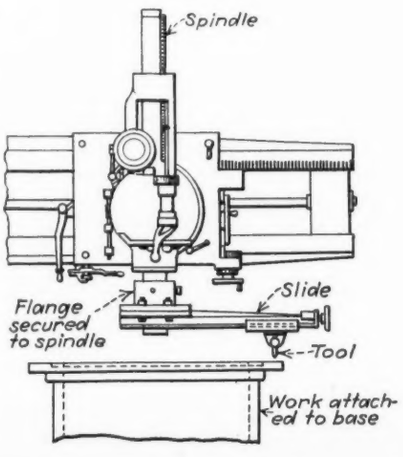
▼ ▼ ▼

Facing Flanges in a Radial Drill Press

THE mechanical department at a gold-silver mine in Central Mexico was recently called upon to recondition the flange ends of two hydraulic turbine intakes. At first it was thought possible to do the job in the lathe available at the shop, but the idea had to be abandoned owing to the size and shape of the parts in question. Lacking a large planer and other suitable tools, the work was finally done in the radial drill press, as explained in the sketch.

The set-up consists of a homemade slide with an adjustable tool-holder, and a steel flange secured to the spindle of the drill press by two setscrews. The slide proper is held to the flange by four bolts.

Operation of the arrangement is relatively simple. After the tool has been adjusted and the first cut made, the drill spindle is run at slow speed and the carriage of the slide gradually advanced toward the center of the work piece on the base of the drill press. Both the slide and the steel flange were made from scrap material.



Phelps Dodge Corporation Will Spend $36,000,000 in Arizona Mines

Total expansion program will cost around $40,000,000

STOCKHOLDERS of the Phelps Dodge Corporation met on May 24 and approved an issue of debentures amounting to $20,285,000. The terms of the issue were announced on May 28 and stockholders receive the right to subscribe to $4 in debentures for each share of stock held. Louis Cates, president, estimates that between five and six million dollars is proposed to be spent by the company in 1937.

The corporation expects that proceeds from the sale of the debentures will be applied to the payment of a part of the cost of a program of capital expenditures over the next five years for various purposes, which include opening and equipping the Clay orebody, at Morenci; completing the enlargement of plant and operating facilities at Ajo; enlarging and balancing fabricating facilities; and making normal betterments and improvements. This program is designed to maintain the productive and operating position of the company over a long-term period. A summarized statement of the approximate amounts expected to be devoted to each purpose comprised in the above-mentioned program of capital expenditures is as follows:

Copper Queen Branch:		
Mining equipment	$506,000	
Smelting and power equipment	2,001,000	
Total		$2,507,000
New Cornelia Branch:		
Equipment for mine and mill		4,171,500
United Verde Branch:		
Mine, mill, and smelter equipment		959,000
Morenci Branch—opening and equipping Clay orebody:		
Advance stripping	$5,360,500	
Pit equipment	5,930,000	
Mill and water supply	9,450,000	
Smelter and power plant	7,100,000	
Miscellaneous	919,500	
Total		$28,760,000
Fabricating Division:		
Miscellaneous Buildings and Additional Machinery		3,573,000
Miscellaneous	885,500	
Total		$40,856,000

The Clay orebody is estimated to contain 245,000,000 tons of ore having an average copper content of 1.12 per cent, and production from this deposit when operations are under way is expected to add about 170,000,000 to 180,000,000 lb. of refined copper to the company's annual output.

Before the depression it was planned that production would start from the Clay ore body in 1934, but low metal prices suspended that objective.

A small amount of underground work has been started at the United Verde by the corporation. William M. Saben is manager. Since the United Verde was taken over by Phelps Dodge, production has been confined to the open-pit work, but with depth this is becoming more difficult and plans are therefore being made for the underground development. It is expected that the pit will continue to furnish ore for another year, after which period it will have reached its economic depth of approximately 600 ft.

The New Cornelia branch at Ajo has purchased another Marion electric shovel. This makes a total of twelve shovels, eight of them steam powered, now operating at Ajo. Michael Curley is general superintendent of the branch. About 1,500 men are employed, 250 being engaged in construction.

▶ The molybdenum property of Ernest Escapule in the Dragoon Mountains is trucking 20 tons of ore daily to Tombstone. The ore is being milled at the Slick Mining & Refining Company's mill on the Escapule ranch a mile southwest of Tombstone.

▶ A test run of the ores of the Bunker Hill properties near Tombstone is being made at the West Side mill. William Miller and Fred T. Graves, of Douglas, are in charge of operations.

▶ Jack King, who recently opened the old Mexican mine at Mineral Park, in Mohave County, has shipped his first carload of gold and silver ore to the Magma smelter, at Superior.

▶ The Humboldt Mines, Inc., at Mayer, is treating 50 tons daily on a one-shift basis. Two carloads of concentrates are shipped each week to the smelter. Walter Larrsen is mine superintendent and William C. Kinnon mill superintendent.

▶ The International Vanadium Corporation, at Globe, has completed its 100-ton mill and power plant and is now in regular production. Recent exploration work has been satisfactory in the development of a large tonnage of vanadium ore. Herbert A. Reed is general manager, Lloyd Wright, of Los Angeles, is president.

▶ The old Senate mine, situated about a half mile from the Congress mine, near Congress Junction, has recently developed some high-grade gold ore. William Hershkowitz and associates are operating the property.

▶ The Sun Beam Gold Mining Company, at Florence, has increased the capacity of its mill from 50 to 100 tons daily. A 900-ft. tramway is being installed to eliminate packing by burros. About 25 men are employed. H. A. Dorrer is mine superintendent. The operations are directed by Glenville A. Collins, of San Francisco.

▶ The Vivian Mining Company, at Oatman, Mohave County, has its new milling plant in steady operation. It is reported that between 25,000 and 30,000 tons of ore are blocked out in the Leland tunnel and Orofino shaft. About 35 men are employed under the direction of Arthur E. Dirrim, general manager.

▶ The Polaris group of mining claims in the Copper King district 8 miles from Clifton has been leased by J. W. Buckley and associates, of Salt Lake City. Work is to be started at once under direction of J. A. Hagen, of Clifton, Ariz.

▶ The Molybdenum Corporation of America, 500 Fifth Ave., New York, has leased the Boriana tungsten mine. Development is planned so as to increase production the next three months. The Boriana mine is one of the largest producers of tungsten in the United States and has been in continuous operation since early 1933. The mill product is a high-grade concentrate with an average of 70 per cent tungsten trioxide and the concentrate is comparatively free from impurities. Some copper as a by-product is also produced. Eighty men are employed and more may be added soon. No change was made in the personnel of mine management. J. P. Seivers is general manager and D. B. Rankin, resident manager.

The St. Joseph Lead Company is making good progress in unwatering the main shaft at the Sheepranch mine, Calaveras County. The new surface plant includes a steel headframe, hoist, compressor and change houses, general office, and repair shops. A 150-ton mill is in course of construction. F. H. Skeels is in charge of operations

California

Walker Mining Plans to Increase Mill Capacity

Production will be stepped up to 2,000 tons daily—New dredge placed in operation in Folsom area

▶ According to a recent announcement, Walker Mining Company plans to install a new 500-ton mill unit at its property in Plumas County, thus increasing the capacity of the present milling plant to 2,000 tons a day. Total expenditure is estimated at $100,000, and the new unit will be ready for operation early in August. L. F. Bayer, superintendent, is in charge.

▶ Construction of the new 1,000-ton mill near Stent by the Calaveras Land Company is progressing at a good rate. All foundation work has been completed and crushing and grinding equipment is being installed. Ore mined by large scrapers will be crushed in two stages by a large jaw crusher and gyratory crusher, the crushed product being stockpiled by a bucket elevator. Grinding will be done in specially designed rod mills operating in closed circuit with large-diameter screen wheel classifiers, and the pulp will be treated in mercury traps and mechanical amalgamators. The plant is expected to be in operation early in July. J. S. Cademartori, superintendent, directs operations.

▶ Installation of a plant capable of treating 1,000 yd. of gravel a day is planned by E. I. Vedder, of New York City, who has recently secured the Snow Point Placer property near Colfax, Placer County. The holdings embrace about 1,000 acres, and preliminary work to be started includes a 200-ft. working tunnel.

▶ Contradicting press reports to the effect that Golden Queen Mining Company has purchased the properties of the Soledad Mojave Mining Syndicate on Soledad Mountain near Mojave, W. G. Browning, general manager of Golden Queen Mining Company, announced recently that a working agreement has been reached between the two companies, calling for the development of a group of claims, known as the Soledad Extension, Soledad Extension No. 1, Hope Extension, Soledad Wedge, Hope Wedge, Pearl, and Roff E., embracing 300 acres. These holdings are in the northwest quarter of Section 7, and with the northeast quarter of Section 7 already held by Golden Queen, the new arrangement gives the company control of the entire north half of the section. The southwest quarter of Section 7 is retained by Soledad Mojave Mining Syndicate, as is title to the property. James E. Babcock is president of Soledad Mojave Syndicate, and development work on the claims turned over to Golden Queen was supervised by W. A. Schauss, with geological work in charge of A. L. Johns.

▶ Constructed at a cost of $500,000, the new gold placer dredge known as No. 5 has been placed in operation in the Folsom district by the Natomas Company. The new unit is capable of handling 350,000 yd. of gravel a month, and weighs about 2,000 tons. Digging depth is 67 ft. below the water level, and the digging ladder is equipped with 110 buckets of 12-cu.ft. capacity. One stacker is used for disposal of tailings. Both the hull and superstructure are of steel construction. Alex Dickson is dredge master. About 3 miles distant the company is erecting a sister dredge to No. 5, to be known as No. 8. Thomas McCormack is president of the company, and R. G. Smith, with headquarters at Natoma, directs dredging operations.

▶ About 550 tons of ore a day are treated currently at the Zeibright flotation plant of Empire Star Mines Company, Ltd., in Bear Valley, near Emigrant Gap. Sinking of the shaft started last year is continuing, and vigorous development preparatory to an early increase in daily production is in progress on the lower levels of the mine. Installation of a new 400-ton grinding unit, a ball mill, and a classifier, to increase mill capacity to 1,000 tons, is contemplated. Operations are supervised by Robert Hendricks, manager. More than 100 men are employed.

▶ Construction of a 100-ton flotation plant is under way at the Rosencranz mine, in Garden Valley, operated by Lode Development Company, Charles H. Brown, superintendent. On the Emma claim, about 1,000 ft. distant, a new shaft is being sunk for exploratory purposes. The new mill is expected to be in operation within 90 days.

▶ Early erection of a 50-ton mill at the Shumway mine, near Kelsey, is planned by the Alhambra and Shumway Mines Company, C. Haliburton, president. Work completed recently includes a surface plant and new hoisting equipment and rehabilitation of the main shaft at the company's Alhambra mine. The adjoining Atlanta mine has been leased by Cline Buckley and Dr. C. P. O. Crabtree, officials of Alhambra and Shumway Mines, and preliminary rehabilitation work has been started. Work at both properties is directed by W. E. Timm, general superintendent.

▶ Mining operations at the Engels mine of the California-Engels Mining Company will be resumed by August or September if the company is successful in raising $72,000 in new capital through the sale of 144,000 shares of stock. The California Corporation Department has already granted permission to issue and sell the additional block of shares to its stockholders on the basis of one new 50c. share for each two shares held. The proceeds will be used to reopen the mine and rehabilitate the 400-ton mill. Company engineers estimate that about 138,000 tons of ore averaging 3 per cent copper remain in the mine. Much of this is above the tunnel level and accessible without unwatering. F. E. Hoar is president of the company.

▶ Milling operations have been started at the Oro Fino mine of Oro Fino Consolidated Mines Company at Ophir, Placer County. The new mill has a capacity of 300 tons, and contains besides the large jaw crusher a Hardinge ball mill with a Hardinge classifier, four Wilfley tables to treat the ball mill screen oversize, amalgamation equipment, and flotation machinery consisting of twelve Kraut cells, a thickener, and an Oliver filter. Underground development work is in progress. J. C. Kemp van Ee is general manager, George Beck, superintendent, and William Lawson, mill superintendent.

▶ To increase production capacity and improve operating efficiency Calaveras Cement Company has started on a plant-expansion program at its plant near San Andreas that will involve an expenditure of about $250,000, according to William W. Mein, president. New machinery in course of construction at the mill includes a $110,000 Cottrell dust collector, a new unit for the clinker-grinding department, and a dense chain system for No. 2 kiln, which is expected to effect material fuel economies.

Utah

Silver King Coalition Prepares to Sink New Shaft

Head frame erected for a 2,000 ft. shaft and surface buildings constructed—Good ore found in Bingham Metal company mine

▶ Interest in Utah mining has been stimulated, with the coming of spring and the reopening of roads into mountain camps, by a resumption of activity at prospects, the speedy progress being made by the National Tunnel and Mines project to tap Bingham at a new low depth, and augmented shipments from mines snowbound throughout the winter.

▶ By the end of June, the Silver King Coalition Mines Company hopes to have completed the installation of machinery at its new surface plant near the head of Thaynes Canyon and to have started sinking. The boarding house, hoist house, and compressor house are completed, the 100-ft. steel headframe has been erected, the 250-hp. Norberg hoist is being installed, compressor put in place, and concrete for the shaft collar will soon be poured. This triple-compartment shaft, 3 miles northwest of the main Silver King shaft, will be 2,000 ft. deep and connected with the workings from the Main shaft on the 1,600-ft. level. For the quarter ended March 31, the Silver King Coalition Mines Company reported a net profit of $429,833.62 after all taxes and depreciation but before depletion, or equal to 35.2¢ per share.

▶ Operations at the Alta Tunnel mine, in Big Cottonwood Canyon, were resumed on May 25. The company is considering the advisability of extending its workings under the divide to get below the mines on the Little Cottonwood side. Ore shipments were started recently by Nick Kolova, operating in the Cardiff mine, in Big Cottonwood Canyon. This ore was taken from the strike on the 1,200 level this winter and stored.

▶ National Tunnel and Mines will soon be driving ahead underground with its 5-mile adit. Open-cut work is progressing rapidly. On June 1 the town of Tooele turned itself over to a celebration of the event with a parade and dedication ceremonies at the portal of the new adit. The new railroad spur to the portal has been completed by the Tooele Valley Railroad Company.

▶ Good ore has been struck in Bingham Metals Company ground at Bingham by the United States Smelting, Refining & Mining Company, which has a lease on the property. The smelting company has driven a crosscut westward from its Niagara 600-ft. level. A crosscut is to be driven to the Gem fissure, which was highly productive in the upper levels of the Bingham Metals.

▶ A drift is being advanced from the top of the West Raise in the West Toledo mine, at Alta, according to A. O. Jacobson, Manager. A 4,000-ft. airline has been run from the Columbus-Rexall tunnel, and two shifts have started to work to reach the intersection of three main fissures. Frank Harris and associates have resumed operations on a surface lease, 750 ft. above company work. A contract was also awarded by the West Toledo Mines Company to Douglas Despain to drift from the 400 level to reach the Manitoba fissure at its intersection with the Cardiff overthrust contact.

▶ Shipments are being made by I. M. Gauchat from the New Premier mine, south of Ibapah. A company is being organized by L. G. Hardy, J. U. Hicks, and associates to operate the Spotted Fawn group of six claims on Dutch Mountain, 7 miles northeast of Gold Hill.

▶ Production of sodium sulphate has been started at the plant of the Salt Lake Sodium Products Company at Saltair, on Great Salt Lake, 20 miles from Salt Lake City. Daily capacity is 100 tons. Twenty men are employed. Glauber salts are scooped up by a gasoline-powered shovel and hauled to the plant. The salts are put into solution, the sand is eliminated by classifiers, and the sodium sulphate settled in tanks. After evaporation of the water, the salt is filtered and dried. The company, headed by Fred W. McEntire, has a lease on 2,800 acres of beach land, underlain by glauber salts at a depth of two feet below the surface.

Idaho

Several Small Mines Plan Reopening

Labor strike at Morning and Page properties affects 800 men and their families—Bunker Hill & Sullivan stock split up

▶ The Morning mine, at Mullan, operated by the Federal Mining & Smelting Company, and the Page mine, at Page, are both idle as the result of a strike or "labor holiday" declared May 14 by the Mullan and Kellogg Miners Unions. About 800 men are affected. Pumps are running at the mines, manned by the technical staff. Pickets have been maintained at the entrances to the mines and mills. Strikers are asking for union recognition and an 8-hour collar-to-collar working day.

▶ Stockholders of the Bunker Hill & Sullivan company have approved the report of directors proposing to split the common stock into four shares for each one share now outstanding. This will make the total number of shares 1,308,000, par value $2.50, in place of the present 327,000 shares of $10 par value. A dividend of 37½c. per share on the new issue was declared by the directors, total payment amounting to $490,500, paid on June 3.

▶ Highland-Surprise Consolidated, operating in the Pine Creek district, has started a crew of men at work preparing underground workings for a resumption of activities. The mill is also being remodeled. Production of lead-zinc-silver ore is expected to begin soon. Dr. Charles Mowery of Spokane, is president and H. M. Huemann, of Wallace, is secretary-treasurer.

▶ Dickens Mining Company, operating the Dickens mine, in the Moon Creek district, east of Kellogg, has entered the list of producers with its 200-ton mill, producing a lead-zinc concentrate. Ore has been mined on the 400, 500, and 600 levels of the shaft, according to Ross Roundy, manager, of Wallace. A 1,600-ft. crosscut from the 600 level is being driven to open ore in the Silver Crescent mine, owned by the same company. Guy E. Riegel, of Spokane, is president.

▶ Coeur d'Alene Mines Corporation, operating in the silver belt west of Wallace is installing machinery for shaft sinking. Herbert Mowery, of Spokane, is president of the company.

▶ Blue Eagle Mining company, Pine Creek district, has started development work, following a shutdown of several years. The lower tunnel will be extended to a point under the upper workings where lead-zinc-silver values were found. Ed McCarty, of Salem, Oregon, is president of the company and William T. Tuson, of Kellogg, secretary-treasurer.

▶ St. Elmo Silver Mines Corporation, located in the silver belt, has let a contract to drive the lower tunnel to the rich lead-silver-copper vein exposed in upper levels. R. E. Weniger, Wallace, is president and T. R. Jones, of Wardner, secretary-treasurer.

▶ The John George lease, in the upper levels of the Bunker Hill mine, in Wardner, is again in full operation, following a shutdown during the depression. Twenty-five miners are employed and a 200-ton mill is working on a one-shift basis.

▶ General Mines Corporation, in the Pine Creek district, is making plans to resume operation. Work will start on an 8-ft. vein disclosed about 2,600 ft. from the portal of the lower tunnel. H. G. Loop, of Spokane, is president and manager of the mine.

COPPER TARIFF

THE "NUISANCE" taxes on copper, lumber, oil, and coal that would have expired on June 30 have been recommended for another two years by the House Ways and Means Committee. The bill was called up on the floor of the House during the week of June 7. Most observers in Washington believe the bill will be signed by the President and the excise tariff on copper will remain for another two years.

View of various leases active on Consolidated Coppermines Company ground in the Lane district between Ruth and Ely, Nevada, with Chinaman lease in the foreground. Ore is sent to the McGill smelter.

Nevada

Mill For Getchell Gold To Be Constructed

Ore near surface will be mined by power shovels—Crown Point mill may increase capacity—Jumbo Mine Leased

▶ Metallurgical tests are being made on ore from the Getchell gold property, in eastern Humboldt County. Surface oxidized ore will be mined by power shovel. Tests indicate the sulphide ore will require a preliminary roast at low temperature. Excavation is completed for a mill, probably of not less than 400 tons' capacity. Nine tunnels have crosscut the ore channel, in places more than 100 ft. wide. Power will be supplied by a line to be built at once from Winnemucca. The mine is 25 miles north of Golconda, at the ease base of the Osgood range. It has been developed during the past eighteen months by the Getchell Mine, Inc. George Wingfield is president and Noble H. Getchell vice-president and manager. The main office is in Reno.

▶ The Goldfield Mining Company, another subsidiary of Calumet & Hecla Consolidated Copper Company, is conducting extensive surface work in the eastern part of the Goldfield district, where it has acquired about 70 claims. Its work is designed to aid in an intensive study of the district geology, in line with that conducted for over two years by the Eastern Exploration Company, which has an option on properties of the Goldfield Consolidated Mines Company and Goldfield Deep Mines Company. Eastern Exploration continues to ship a substantial tonnage of high-grade ore to the smelter.

▶ Bentonite mined in hills east of Walker Lake, Mineral County, is purchased by the United States Navy. The product, crushed to 1-in. size, is trucked up a steep road on the east slope of Mount Grant to the Rose Greek reservoir, 7,000 ft. above sea level, and dumped in the reservoir bottom to seal fissures through which the water escapes. The reservoir was constructed to supply mountain water to the navy base near Hawthorne. The hard bentonite is mined from veins in tuff. It is learned that at the Coulee dam project in Washington, bentonite, known there as Volclay, is similarly used.

▶ Properties of the Tonopah Mining Company of Nevada, worked in late years by lessees, produced in 1936 ore having a gross value of $602,918.39. Smelter shipments aggregated 12,939 tons of dry ore containing 5,972 oz. gold and 512,301 oz. silver, according to the annual report. From this ore the company received royalties of $108,997.78, and its net profit was $83,523.29. The General Metals Recovery Corporation, treating tailing from the old cyanide plant at Millers, paid the Tonopah Mining Company $27,912 in royalty on 194,318 tons of tailing, this source yielding net $26,063 and making total profit from the Nevada properties $109,587. Satisfactory results attended work on a gold prospect in the Cimarron district, 30 miles north of Tonopah. Operating losses and cost outlay at the Vertex in Colorado, in Nicaragua, Ontario, and at Flin Flon, with small earnings by the company's Tonopah & Goldfield Railroad, reduced the year's net to $67,310.38. Horace A. Johnson, of Tonopah, is in charge in Nevada.

▶ With rated capacity of 100 tons per day, the Crown Point mill of the Sutro Tunnel Coalition, Inc., at Gold Hill, on the Comstock lode, has been treating around 125 tons from Crown Point underground workings and from two surface open cuts on the lode outcrop. Capacity probably will be at least doubled soon. Surface cuts are on the Crown Point and Imperial mines. Sutro Tunnel Coalition, Inc., is a wholly owned subsidiary of Comstock Tunnel & Drainage Company. J. M. Leonard is manager.

▶ Construction of a 50-ton mill, employing table concentration and magnetic separation, is in progress on property of the Nevada Tungsten Corporation in the Pine Nut range in Douglas County. Substantial bodies of scheelite, sampling 1 per cent WO_3, have been developed in the past two years under direction of H. E. Loufek, of Reno, president and manager. H. G. Walker, of Reno, is consulting engineer.

▶ An orebody opened in the Overman mine of the Consolidated Chollar, Gould & Savage Mining Company below Gold Hill in the Comstock district is proving to be of large volume, with a width of 20 to 30 ft. and now opened for a length of 400 ft. Sampling was said to indicate an excellent mill grade. During the first quarter of 1937 the flotation mill produced concentrate worth $88,867, with net of $25,523 before depletion, depreciation, and taxes. In 1936 the mill treated 123,587 tons, including 15,449 tons of custom ore from the Ophir workings of the Consolidated Virginia Mining Company. Gross recovery was $293,823, of which $19,213 accrued to the Consolidated Virginia. Net for the year was $72,984, of which $29,060 was expended for 1,368 ft. of development work. Sidney W. Fish, formerly of New York, is president; Thomas V. Barton, of San Francisco, is managing director, and V. F. Dempsey superintendent.

▶ Gold discoveries in the Box Canyon district, southwest of Jungo in northern Pershing County, have attracted wide interest. Late last year, when prospecting for placer gold in the canyon bed, Fitzgerald, Taylor, and Garner found coarse gold in vein outcrops. They located claims, which were shown by survey to be on patented railroad land. Utah men became interested, bought the land from the Union Pacific Company, and have exposed high-grade gold ore in a 40-ft. shaft and at other points. Several other interesting finds are reported in the vicinity of the discoverers' Black Jack group.

▶ Ten modern apartment houses are being erected at a cost of $107,000 at Mountain City by the Mountain City Copper Company, controlled by the International Smelting Company. By erection of these houses, 80 families can be accommodated with three-room apartments. Each apartment will have running water, electricity, and modern plumbing. The Copper Roofs Company, of Utah, a Salt Lake City corporation, is supplying copper roofing. Lynch-Cannon Engineering Company, of Salt Lake City, is constructing the apartments. R. Young, of Salt Lake, is doing the engineering work.

▶ George Austin and attorneys for parties involved have confirmed terms of a lease and option on the Jumbo gold mine, in the Awakening district, Humboldt County. J. K. Wadley, of Texarkana, Ark., and H. L. Hunt, of Tyler, Tex., oil operators, paid Austin on May 28 a certified check for $250,000 on account, the total purchase price being $10,000,000 if option to buy is exercised within twenty years. The lease extends for 35 years, and royalties of 20 per cent above $15 ore and 10 per cent below that figure will be paid applying on purchase price, but payments must total $100,000 yearly. The six members of the Austin family share equally in the payments. Two suits against Austin now pending based on grubstake claims will be defended by the purchasers.

NEWS FROM Washington

By Special Correspondent

THE PRESTIGE of the President has suffered sadly during recent months. Congress is now anything but a rubber stamp. The proposed enlargement of the Supreme Court was the major wedge which has split off great factions and weakened the allegiance of many who remain at least nominally loyal.

Reestablishment of unquestioned leadership on the part of the Chief Executive is not expected. But it is a great mistake to assume that Congress is going to run riot, ignore the White House, or do much in the way of initiating legislation of its own. Congress would really like to go home, and may even decide to do so when the necessary appropriation bills are out of the way. That is about the only way that Congressmen see of escaping continued White House pressure for things they do not want to vote on, either for or against.

This change in the attitude of Congress is not surprising in view of the fact that the crisis philosophy no longer is persuasive. The depression emergency has so evidently passed that Congress gags when asked to swallow emergency-type measures.

Appropriations

THE HOUSE of Representatives Committee on Appropriations, in reporting to the House its recommendation regarding funds for the Interior Department next year, suggests slightly less money for the United States Geological Survey and for the Bureau of Mines; also a small cut from last year's total. The Survey curtailment applies only to the fund for leasing of minerals on public lands and Naval petroleum reserves. This cut is partly offset by slight suggested increases for work in stream gaging and in printing of geologic maps. Fundamental geologic, topographic, and mineral studies will be conducted with the same moneys as last year if the House committee recommendation carries through to final enactment.

Several of the items of the Bureau of Mines list of activities are increased as compared with last year's appropriations. These increases, for fuel testing, mineral mining investigations, and mining experiment stations, are much more than offset by a cut of about $63,000 for the economics of mineral industries. The committee says:

"In recommending a reduction of $62,700 in the estimate of $337,490 for this activity the committee has taken into consideration the work which will undoubtedly be undertaken by the new Bituminous Coal Commission authorized by a recent act of Congress. This agency will unquestionably collect voluminous data and statistics in connection with the bituminous coal industry, which is now being performed by the Bureau of Mines, and it is with a view to preventing duplication of this work that the committee has recommended a reduction in the estimate."

The committee report to the House also includes the following significant paragraph:

"The committee recommends that the Secretary of the Interior shall have a study made of the branch organization of the Bureau of Mines, other than by the Bureau itself, with a view to the possible abolition of what appears to be an unnecessary encumbrance and expense. It seems advisable to the committee to re-establish the direct, over-all supervision of the Bureau's divisions by its Director, as was customary from the Bureau's establishment until the administration of its last previous Director."

These two quotations appear to reflect the desire of Representative Scrugham, of Nevada, that the economic investigations of the Bureau of Mines be sharply curtailed. When such effort has previously been made by him the Senate has not been willing to concur. Nor is it really expected that the Senate will want to transfer statistical fact-finding from the Bureau to the Coal Commission. The latter, Washington observers believe, will ultimately prefer to have the fundamental statistical work done by the Bureau, so that no question need be raised as to the correctness, impartiality, or adequacy of the data.

The situation is developing into a matter of State and regional controversy. One commentator has even gone so far as to say, "Uneconomic deposits in Nevada which require technologic nursing and indirect subsidy are allowed to dictate the policy of the Government and decide what investigations shall be made for the service of mining and minerals. One-half of 1 per cent of the value of mineral production comes from that State, but seemingly 100 per cent of the House of Representatives' mining and mineral policy." This refers, of course, to Representative Scrugham's valiant effort to stimulate electrochemical processing of Nevada deposits with power from Boulder Dam at the expense of general economic studies. The influence of the Representative as chairman of the appropriation subcommittee which handles Bureau of Mines and Geological Survey funds indicates the importance of his opinion in shaping all mineral policies.

Copper "Surplus"

OFFICIALS IN WASHINGTON would like very much to know just what happened in the reported conference of world copper producers held in New York in mid-May. They suspect that nothing definite transpired, because other meetings are to be held in London in June. The unsettled question is whether a curtailment program by foreign producers is imminent. Mineral economists continue to spotlight in their thinking the disparity between the present rate of copper production, 2.6 million short tons per year, and the world's peak of copper consumption, 2.1 million tons. Surely, they argue, a half million tons per year of copper can go into military reserves for only a limited time. European stock piles ought by now to be big enough for even the most militaristic of officials.

THE FUNDAMENTAL QUESTION raised in Washington is, therefore—Shall we expect curtailment of buying, with possible further collapse of prices; or are there new unnoted large consuming activities which will advance copper use above previous peaks? Government officials admit they do not have the answer. Furthermore, they think that the same philosophy may apply to numerous metals other than copper.

Reorganization

REPORTING its fact-finding to the special Senate committee on reorganization, the Brookings Institution gives the following résumé of the mineral resource activities of the government:

The agencies engaged in research and regulation in connection with mineral resources are the following:

"1. Geological Survey (Interior Department), which deals with the occurrence and distribution of minerals, including water.

"2. Bureau of Mines (Interior Department), which deals with technological problems of mining and oil extraction, safety, utilization of products, and promotion of trade.

"3. Petroleum Conservation Division (Interior Department), which deals with the administration of the Connally Act of Feb. 22, 1935, prohibits interstate shipment of oil in excess of the production permitted by State law, acts as adviser to the Secretary of the Interior on petroleum matters, and cooperates with the oil-producing states in the study of physical waste.

"4. National Bituminous Coal Commission (Interior Department), which was created to regulate the price of bituminous coal and also has authority to make studies in the field of safety, trade, and costs of mining. Its power to regulate prices was declared unconstitutional on May 18, 1936.

"5. Bureau of Foreign and Domestic Commerce (Commerce Department), which is engaged in foreign-trade promotion, but whose functions as regards trade in metals and minerals were transferred to the Bureau of Mines in 1935."

From these facts, four recommendations about mineral resources are presented, viz.:

"1. That the Geological Survey and the Bureau of Mines be kept distinct.

"2. That the work of the Petroleum Conservation Division be restricted to enforcement of the Connally Act and to advising the Secretary of the Interior on petroleum policy, and that studies looking to the prevention of waste be transferred to the Bureau of Mines.

"3. That research activities of the National Bituminous Coal Commission be transferred to the Bureau of Mines.

"4. That the National Bituminous Coal

Commission be discontinued unless regulative and administrative functions are restored to it."

From the general text of the report it is evident that the Brookings investigators expect the Bureau of Foreign and Domestic Commeree to discontinue that part of its activities which duplicates the work of the Bureau of Mines. However, they do not make any specific recommendation to that effect.

Mine Efficiency

A YEAR AGO funds from W.P.A. were provided to study "the major changes discernible in the technology of mineral extraction, and to point out such probable effects upon the economy and the social organization of the country as seemed to be clearly indicated." The first report on this joint project of W.P.A. and the Bureau of Mines was released late in May under the title "Technology and the Mineral Industries." (Copies are being distributed by W.P.A. National Research Project, Philadelphia, Pa., Dr. David Weintraub, Director.)

The statistics gathered clearly demonstrate the large increase in output per worker in the mines of the United States. Advances in coal, oil, and gas are large, but the productivity per man in copper, iron, sulphur, phosphate rock, and gypsum is even greater. Moreover, the data show also that the percentage of those gainfully employed in mineral extraction has, with the exception of the depression period, increased steadily. In 1930, however, the percentage of gainfully employed so engaged was only 2 per cent, in contrast with 2.7 per cent ten years earlier.

In commenting on this report officials point out that new technology has been necessary for three reasons:

1. Deeper mines and leaner orebodies could not be worked at all with the old techniques.

2. There were not enough available workers to use old methods and produce metal and minerals equal to the demand.

3. The cost of mining by the old methods under less favorable mine conditions (and with much higher wages per hour) would have made prices prohibitive long before now with the old techniques.

Officials point out, therefore, that technologic advance in mining has contributed to social well-being in a number of ways. It has permitted continuing employment where otherwise mine abandonment would have been necessary. It has permitted lowered cost, which in turn stimulated increased usage. It has advanced the standard of living by maintaining increased cheap supplies of metals and minerals for new applications and more generous supply for old uses.

"Economy" Budget

THE PRESIDENT at last is seeming to work for economy. Previous requests to Congress and promises to the public meant little. It required a severe strain on the Federal bond market to convince the President that Morgenthau and Eccles are right. There is some limit on safe spending by the Government.

But the President has no desire to cut relief where cutting on a substantial scale would be possible, though politically embarrassing. Nor would the Chief Executive care to have Congress provide the requested $1,500,000,000 for relief with a proviso that it must last for twelve months. Congress is not likely to hamstring W.P.A. technique in that fashion, though a majority of Congressmen individually would probably love to do this.

Future of Minerals

THE W.P.A.-BUREAU OF MINES report makes important summary as to the immediate mineral outlook. It says:

"The short-time prospect is one of increasing abundance. Generalizing where conditions vary widely, we may conclude that for the immediate future—say for the next ten years—mineral technology will not only succeed in overcoming the increasing handicaps of nature but may be counted on to effect further savings in the labor required to obtain a unit of product.

"For the mineral group as a whole, the increase in output per man hitherto observed may be expected to continue, though probably at a slower pace than during the 1920's. Where exceptions to the general tendency occur and depletion absorbs all of the gains of technology, as may happen in certain of the minor metals, alternative supplies seem assured from other sources or from substitutes.

"Whether the savings of labor per ton result in actual decline in employment depends upon the factor of demand, which depends in turn upon many other factors."

LONG-TIME OUTLOOK — The corresponding more distant prospect is then summarized as follows:

"Over the longer view, however, the prospect is one of growing difficulties in which technology has a harder time to overcome the handicaps of nature. The arrival of such a stage of increasing cost is forecast by the past experience of individual mines and the older mining districts the world over. When the time comes that new sources are no longer available, more of the world's mineral industry must pass into the stage already locally familiar where the gains of technology can no longer suffice to offset the increasing handicaps of nature.

"Unfortunately for social planning, we can be much surer of the probability of such a period of increasing costs than of the date at which it will appear. . . .

"It is the prospect of such an increase in costs that creates the problem of mineral conservation. Absolute exhaustion of any mineral could happen, if at all, only in the distant future; increasing cost through depletion of the best resources has already arrived in some branches of mining and may be expected in still others within the span of men now living. It is therefore the simplest common sense to prolong the period of abundance by the elimination of preventable waste. . . . On the whole, the technologic developments in prospect increase the potential recovery of the resource. The problem of conservation is largely to encourage an organization of the mineral industries that will permit the savings in resources which technology has already shown to be possible."

Balancing the budget by new taxes to be enacted soon seems less likely now than a month ago. A thorough study of the fundamentals of the taxation policy of the nation is being made by the Treasury Department. The results cannot be presented immediately. Unless Congress stays through the summer or recesses and comes back in the fall (most unlikely), the findings will wait. Most probable appears a special pre-session meeting of the interested Congressional committees, perhaps in November. Hearings could be held then and a bill whipped into condition for early enactment next year.

Congress hates to pass tax legislation of this sort just before elections, but it will probably have to do so. And it is most likely that the taxes enacted in the winter of 1937-38 will be levied on the incomes of 1937. Mining executives who are good guessers will naturally have to set aside some funds to pay these taxes. This is another unpleasant and complicating factor when it comes time to guess what dividend rate should be fixed to avoid as far as is possible the levies on undistributed income.

Power Policy

CONTROVERSY over the selection of an authority to fix power rates at new federally owned dams continues to rage in Washington. The several efforts of the President to secure something like unanimous support for one plan or another have all failed. Differences between those who would have a flock of T.V.A.-type agencies and those who would put the whole arrangement under the Federal Power Commission seem irreconcilable. The President himself is compelled to decide on a plan. And there is certainly no expectation that Congress will adopt even his findings without further debate and probable amendment.

As near to an impartial set of findings as can be expected from anyone is found in the Brookings Institution's recommendations to the Senate committee on reorganization. That agency believes that a joint board of Federal Power Commission and Securities and Exchange Commission should pass on matters having interest for both. It is then recommended—

"That all power activities of the Government, with the exceptions noted, be subject to supervision by a single agency, either the Federal Power Commission, or a new Federal Power Administration."

The authority now lodged with P.W.A., R.E.A., E.H.F.A., the Departments of Agriculture, Interior, and War, and the various commissions and policy-making groups would all be transferred under this finding. These Brookings specialists even go so far as to make a final recommendation:

"That proposals for the development of Federal power projects require the approval of the Federal Power Commission, which should also have supervision over production and rates."

Mining interests which would like to use some federally generated power must not expect that so impartial a finding as this is going to be adopted soon, if at all. It sounds too simple to be acceptable under present alphabetic thinking of Washington.

Colorado

Interest Grows on Ore Below Roosevelt Tunnel

Deeper exploration planned as a result of finding good mineralization below drainage tunnel—Diamond drilling in Iowa Gulch

▶ Recent ore strikes in the lower levels and especially in the mines of the Cripple Creek district where the shafts have been sunk below the Roosevelt drainage tunnel, have spurred the larger operators in the district to undertake deeper drilling and exploration. The Cresson recently installed pumps which had been pulled and is planning to seek the lower measures of the Cresson blow-out. The move on foot at this time is to tap the downward extensions of ore zones. The new drive will start from the $35,000,000 Vindicator, with the first objective being the Hull City property. These developments indicate the desirability of a lower drainage tunnel in the district.

▶ An outstanding development of recent weeks at Ouray is the construction by the San Juan Metals company of a new 150-ton mill and boarding house. The Treasury mine has a 6,200-ft. tunnel. The mine is located near the top of Red Mountain pass between Ouray and Silverton.

▶ G. A. Franz and associates, operators of the Banner-American mill, in Ouray, have purchased the Saratoga mine, smelter and numerous claims.

▶ William McCullough, superintendent of the Hidden Treasure property, plans to extend the company's tunnel an additional 2,000-ft. This property adjoins the Camp Bird mine.

▶ The new East Argentine Mining & Milling company, operating the Sydney tunnel, has completed rehabilitation and dewatered the winze on the Ontario vein. Good milling ore is said to be developed.

▶ Messrs. Johnson and Zadra, operating the Black Diamond claim through the Sangre de Cristo tunnel, have encountered dollar a pound ore on the second level of the winze. This property is at Cripple Creek.

▶ The Portland mine of the United Gold Mines has built a new compressor house at the No. 1 shaft and moved the three large compressors to the new locations.

▶ The Colorado Custom Ore Milling Company, operating the Cardigan mine, in Spring Gulch, in the Idaho Springs district, has started developing the May Day and others in a group of mines through the Torpedo Tunnel.

▶ The Bellevue-Hudson, an old property in the Lawson district, is being developed. At the Clear Creek tunnel, at Dumont (in the same district) the crews are pushing the bore and stopping the No. 10 and Equinox veins, where good ore has been encountered. A new 150-hp. compressor which will drive seven drills has been installed.

▶ The Kaminky property, near Silver Lake, has installed a new compressor. Good ore is reported exposed in the drifts and raises. Not far from Alice the Semiprone is developing good ore and will soon be shipping. R. A. Patterson, of Georgetown, is president and general manager. Other properties resuming operations in this section are the Lalla mines, the York, Hamlin and Cumberland gulches, and Silver Creek.

▶ The Shurtloff mine shipped about 45 cars of ore in April, that ran from $6 to $23 per ton. The Tennessee Mines are shipping a car of ore daily from the Patti Rosa mine.

▶ Diamond drilling has been started by E. C. Congdon, of Duluth, on the Clear Grit property, in Iowa Gulch, 4 miles southeast of Leadville. The geological and engineering direction of the work is in charge of E. J. Longyear Company, of Minneapolis.

Michigan

Quincy Mine Starts Operations

Production will be confined to Shafts No. 6 and 8—Unwatering at Isle Royale mine

▶ The Quincy mine, after several months of preparation, resumed the hoisting of copper rock in No. 8 shaft on May 24, the first since the property was shut down in September, 1931. Decision to reopen the mine was made by the board of directors of the Quincy Mining Company on Sept. 10, 1936, since which time the shafts have been unwatered and repairs made. Working operations at the start will be confined to Nos. 6 and 8 shafts. No. 2 will be in operation by fall. It is expected that production can be started in No. 6 shaft by the latter part of June. In No. 8, the 75th, 77th, 79th, and 81st levels are ready for production. In No. 6 shaft the operating levels will be the 85th, 86th, and 87th levels.

▶ At the Isle Royale mine, which will be reopened by a reorganized company, preparations are being made to unwater the shafts. Bailers as well as pumps will be used. Repairs are being made to surface equipment. Bailing and pumping will be under way soon.

▶ Payment of a dividend of 50c. to Calumet & Hecla stockholders on June 16 also means the payment of a bonus of $25 to employees. The increase in the dividend rate from 25 to 50c. also brought a similar increase in the bonus, the latter being the equivalent to the dividend on 50 shares of stock. Payment of a bonus is in line with a policy adopted a year ago. To date three bonuses of $12.50 each have been paid and meanwhile several increases in wages have been made effective. Employees now are receiving peak-time pay. Dividend and bonus payments in this district alone June 16 will total approximately $220,000.

Montana

Mill at Moorlight Mine Destroyed by Fire

Producer of manganese forced to suspend operations—New cyanide plant to be erected for Broadway mine

▶ The mill at the Moorlight mine, 2 miles east of Philipsburg, was destroyed by fire on May 14. The cause is not known, but the belief held is that it resulted from an oil explosion in the roasting division of the plant. The mine is a producer of manganese, and about 60 men are reported thrown out of work. The loss is estimated at $100,000. John Hickey is mine manager.

▶ Unwatering at the Broadway mine, near Silver Star, has been completed to the 650 level. After sampling, the water was allowed to rise to the 550 level. A new shaft will be sunk and levels established at 200-ft. intervals. The condition of the workings in the bottom levels below water was found wholly accessible and free from caves and, the vein is wider, in some places, up to 15 ft. Orders have been given for the construction of a 100-ton cyanide plant to be ready for operation in July. A. V. Taylor, Jr., is in charge of operation.

▶ Development work in the Victoria claim, near the Broadway mine, has progressed rapidly, and a substantial tonnage of low-grade milling ore is now available. The Broadway-Victoria group is under option to the Taylor, Wilson & Knapp Corporation, which also operates the Two Percent mine in the Philipsburg district.

▶ During the spring months, operations at the Ruby Gulch mine, of which George Whitcomb is manager, have been successful. The 300-ton cyanide plant has been working continuously, and shipments of high-grade ore have been made to the East Helena lead smelter of A. S. & R. According to statements by officers of the company, the entire expense of reopening and rehabilitating the property has been repaid and a small dividend was recently declared. The high-grade shipping ore is from a new strike in the Alabama workings one-half mile south of the Ruby Cut.

▶ The Boaz mine, in the Norris district, continues to ship high-grade ore, from which it returned 100 per cent dividends to its owners in 1935 and 1936. It is reported that new ore has recently been developed, from which the present production is being obtained.

▶ It is reported that the A. O. Smith Co. entered negotiations for the operation of the Golden Sunlight property near Whitehall, and the construction of a mill. The company is also planning to test the Tourmalene property, near Boulder, by diamond drilling. Wade V. Lewis has been identified with the latter property for the past few years.

Tri-State

Zinc Mining in Southwest Missouri More Active

Scrapers installed at the D. C. & E. mine, in the Oronogo-Webb City district—Federal Mining & Smelting company will operate Early Bird and Big Elk mines

▶ The Eagle-Picher Mining & Smelting Company is equipping the old D. C. & E. mine, in the Oronogo-Webb City field, for mechanical loading and transportation of the ore. Four scrapers will be installed underground for loading the ore onto a 24-in. conveyor belt which will transport the ore to the skip pocket at the shaft. The steel headframe and skips from the No. 8 shaft on the Netta lease, in Picher, are being installed at the D. C. & E. shaft. If this experiment, with its reduced mining costs, proves feasible, it will make available large tonnages of low-grade "sheet-ground" ore in this area which have been unminable in the past.

▶ Mining operations in southwest Missouri continue to expand. The Hays-Manning Mining Company recently put its mill on the Page land east of Joplin into operation. This mill has a capacity of 20 tons of ore per hour. A new shaft has been sunk to a depth of 100 ft., where zinc-lead ore is being developed. The Joplin Mining Company has leases on 120 acres near Pioneer, in Barry County, and will begin prospecting with a churn drill. C. F. Denney has leased approximately 1,500 acres near Reeds, in the eastern part of Jasper County. It is reported a drill hole recently completed to 270 ft. showed a 50-ft. face of zinc and lead ore. C. C. Playter, who operates a custom mill at Waco, has taken a lease on land northeast of Burgess. He will install a 6-in. Pomona pump in one of the old shafts and expects to have the water lowered to the 140-ft. level by late June. The Manda Industrial Corporation will mine the properties of the former Stark City Lead & Zinc Company in the edge of town. The ore will be shipped by rail to the Central mill of the Eagle-Picher Mining & Smelting Company near Commerce, Okla.

▶ The smelter of the American Mine & Smelting Company at Van Buren, Ark., has recently been sold to the newly organized Arkansas Smelting Company. Officers of the new company are as follows: President and treasurer, B. H. Jacobs, chief accountant, Eagle-Picher Mining & Smelting Company; secretary, John W. Campbell, personnel manager, Eagle-Picher Mining & Smelting Company; vice-president, A. C. Wallace, Miami, Okla., attorney. Work started about May 15 to put two blocks of retorts and one roaster in condition for immediate operation. About 100 men will be employed when the plant is in operation.

▶ Federal Mining & Smelting Company has purchased the underground leases of the Early Bird and Big Elk mines, northwest of Treece, Kan., from C. Y. Semple. The ore from the two mines, which are both located on lands of the John M. Cooper estate, will be trucked to the recently rebuilt Muncie mill, which joins the Early Bird mine on the west. A new derrick and hopper is being erected on an old shaft near the southeast corner of the Big Elk lease.

▶ The Beaver tailings re-treatment mill of the Commerce Mining & Royalty Company started operations on May 24. This mill was moved from the John Beaver lease to the Anna Beaver lease, which adjoins it on the north. The rebuilt mill was enlarged to treat 125 tons per hour, making it one of the largest tailings re-treatment plants in the district.

Iron Country

Iron Ore Producer Signs Agreement With CIO Unit

Forty hour week with time and one half for overtime and double time for holidays agreed to—Ore shipments continue at high rate from all the ranges

▶ Organized labor entered the Iron Country some time ago and has signed an agreement with Butler Brothers, a Minnesota mining company. The various independent and other mining companies have maintained a 40-hour week with time and one-half for overtime, the sixth day being overtime. A great deal of overtime has been given the men and pay checks are larger than at any time in the iron-mining industry. Butler Brothers prior to the agreement, paid higher rates per hour but only straight time for overtime. A Steel Workers' Organizing Committee called on Butler Brothers on behalf of the members of the Amalgamated Association of Iron, Steel and Tin Workers, an affiliate of the Committee for Industrial Organization, and made certain demands. On May 13 an agreement was reached with Butler Brothers whereby the company recognizes the union as the collective bargaining agency for those employees who are members of the Union. A 40-hour week with time and one-half for overtime and one week's vacation with pay was agreed to. The hourly rate previously given was reduced in view of time and a half for overtime. Double time will be paid for working New Year's Day, Christmas, July 4, Labor Day, and Thanksgiving Day. Grievance committees have been appointed to settle arguments arising from discharges of members. The Steel Workers' Committee was composed of Henry Burkhammer, William Hartman, and Florindo De Luca. Most of the terms have already been carried out by all the other mining companies. Rumors were to the effect that the next move would come to the Wisconsin steel companies' properties and also to the Jones & Laughlin, but it is known that several men of all organizations have signed up with the union. It is thought that after the recent poll in the steel mills an effort will be made to sign up all the iron-mining companies. The Oliver Iron Mining Company has a so-called union made up of its own employees, with no management representation.

▶ Mining deep ore in open pits by use of conveyors is now practiced at the Canisteo mine, at Coleraine, Minn. In cases where the grades make it impossible to take this ore out, the conveyor is used. The ore is loaded into a pocket which discharges into a pan conveyor and carried on a belt to the railroad cars. The pocket can be moved around by the power shovel and the conveyors can be moved to take care of the loading in the various areas to be mined.

▶ Shipments of iron ore are going forward rapidly and the railroads are being rushed to capacity. The original schedules are being followed and in some cases increases have been made. If the season is as large as predicted an all-time high mark will be reached in the shipments of iron ore. It is reported that the shipment of over 1,000,000 tons of iron ore during April over the Great Northern was a record for this transportation company for any April in its history.

▶ The new washing plant of Butler Brothers at the Merritt mine, Trommald, Minn., is now in operation. The Shada mine, at Nashwauk, operated by C. K. Quinn & Company, will soon be shipping ore.

Bolivia

Tin Production Expected To Increase

Government gives producers more favorable terms on exchange—Patiño Mines report lower ore reserves

▶ Owing to more favorable terms on exchange between the government and tin producers, Bolivia is expected to export larger quantities of tin. The operators, according to press advices from La Paz, have pledged themselves to export monthly a minimum of 2,500 tons. Thirty-five per cent of their receipts will be delivered to the government instead of between 42½ and 40 per cent. The treasury will pay the operators at the rate of 60 bolivianos to the pound sterling instead of 40 bolivianos.

▶ Patiño Mines & Enterprises in 1936 produced 7,324 English tons of fine tin, compared to 8,924 the previous year, and a decrease in ore reserves equivalent to 3,868 tons of fine tin was reported in the company's annual report. Since expenses in Bolivian currency are small, deliveries of drafts to the Bolivian Government results in a large accumulation of Bolivian currency beyond the company's needs.

Correction—In the April issue of *Engineering and Mining Journal,* in news from Bolivia on page 211, there appeared a typographical error which should have read "Deister-Overstom tables" instead of "Denver Overstrom tables."

Wide World Photos

A huge tailings dam of the Dos Estrellas Mining Company, at El Oro, Michoacan, Mexico, was washed away on May 27, following several days of unusually heavy rains. Part of the 14,000,000 tons of tailings that killed about 100 persons can be seen rushing toward the village of Tlalpujahua. Similar disasters occurred in Japan in November and December last year

Mexico

Phelps Dodge Reopens Moctezuma Copper

Moderate production of ore planned—Two companies seek permission to suspend operations—Cusi Mexicana Mining curtails operations

▶ Moctezuma Copper Company, a subsidiary of Phelps Dodge Corporation, is preparing the copper mines at Pilares de Nacozari for the resumption of production on a moderate scale. Operations were suspended in September, 1931. Personnel has been hired for the undertaking.

▶ Companies asking suspension sanction from the Federal Government are Amparo Mining and Cia. Minera Piedra Bola, both operating in Etzatlan municipality, Jalisco. They contend their principal deposits are exhausted or are rapidly approaching that status. Auctioning proceedings are asked for Atalaya Mining and for Cia. Minera Montecarlo y Anexas, working in the Totolapan and Tetipac zones, Guerrero, respectively.

▶ Thirty metric tons of gold-copper ore, the first consignment from the new mining zone at El Toro, on the borders of northern and southern Lower California, has been shipped to the smelter at El Paso, Tex.

▶ Two hundred workers have been dismissed by Cusi Mexicana Mining, operating at Cusihuiriachic, Chihuahua, in accord with its program to lay off the force gradually before suspending work. Exploration during the past three years has failed to find new ore along the Cusi fault, therefore the company is forced to curtail operations.

▶ Cia. Explotadora de Minerales y Metales de Zacoaplan, operating at Zacoaplan, State of Mexico, has been accused, by its employees, before the Federal labor authorities, of suspending work without justification.

▶ Asarco has avoided some labor grief at its Charcas unit, San Luis Potosi, by allowing a minimum daily wage of 3 pesos (about 83c.), a general pay increase of 50 centavos (14c.) a day and agreeing to provide the miners' union with 5,000 pesos ($1,400) annually to finance its social works, as well as 4,500 pesos to defray costs of arranging the new collective labor contract, and to provide two free buses to convey workers to and from employment places. D. J. Pope and Ricardo E. Mora signed the agreement for the company, which granted these concessions, although it claimed that the company is losing 400,000 pesos a year.

▶ Normalcy has been restored at the La Reforma mines, Hidalgo, by Cia. Minera Dos Carlos signing an agreement that ended labor troubles which lasted for nine months. Workers' demands for higher pay are being considered by the Federal Board of Conciliation and Arbitration. Carlos Vidales, mill superintendent, signed the contract for the company.

▶ Metal production, excepting that of copper and some of the minor metals, increased last year over the record for 1935, as shown in the following table. Amounts are in kilograms.

Metal Production

Product	1936	1935
Gold	23,451	21,223
Silver	2,409,397	2,351,087
Copper	29,713,065	39,372,887
Lead	215,723,930	184,193,186
Zinc	150,250,839	135,921,457
Antimony	7,303,423	4,569,675
Graphite	10,254,102	6,975,724
Mercury	182,959	216,394
Arsenic	8,526,713	9,950,386
Molybendum	890,169	1,144,487
Bismuth	165,548	213,583
Cadmium	535,017	597,527
Tin	373,476	630,749
Tungsten	52,240	49,649
Selenium	280	.....

▶ Cia. Minera El Potosi, Santa Eulalia unit, Chihuahua, in addition to signing a labor contract previously reported, has also given each laborer a free 1,000-peso ($280) life insurance policy and has donated 50,000 pesos ($14,000) to establish a clinic for ill or injured workers.

▶ That work is to be resumed in the near future at copper mines in the Pilares de Nacozari district, Sonora, is indicated by progress being made in negotiations by H. H. Horton, American mine operator, with the Sonora government.

▶ American Smelting & Refining Company has granted employees of its Huicicila unit, Nayarit, wage increases and other benefits similar to those allowed workers of its Angangueo, Michoacan, and Charcas, San Luis Potosi, units. A. W. Edelen, assistant manager of the company, signed the Huicicila agreement.

▶ German-Mexican interests represented by R. C. Meentz and Ernesto Davila have asked the Sonora government for a concession to revive activities at the El Alamo mine, Huachinera municipality, a gold-silver property that was abandoned some years ago.

▶ An injunction was obtained by Cia. Minera El Cubo, Max F. Quinn, general manager, at Mineral del Cubo, Guanajuato, against the Federal Labor Department imposing a fine of 1,500 pesos (about $425) because the company allegedly failed to pay some employees for a weekly holiday. The company argued that the employees had not served the six consecutive days the law requires before enjoying a paid holiday.

▶ Syndicate of Mexico City foreign and Mexican mining men have organized Aragon, S. A., to engage in general mining. Backers of the enterprise are Sidney and Richard Hedley Ludlow, Antonio Maria Alvarez, Jose Hermosillo, and Ricardo Garza Huerta.

Canada

Exploration Resumed on Pyrite Deposit

Option taken by Vancouver interests—Consolidated Mining & Smelting considering reopening the Coast Copper Mine

▶ In the Portland Canal district, operations have been resumed at many small properties. It is expected the 500-ton underground mill at the Big Missouri will be completed by midsummer. After an idleness of eighteen years the Estollpyrite deposit near Prince Rupert will again be examined. In 1919 the Granby Company did 11,000 ft. of diamond drilling with the object of finding ore with copper values sufficient to warrant acquisition of the property as a copper mine, but results were inconclusive. Since then achievements in metallurgical research have improved the possibilities of the property considerably, and an option has been taken by F. W. Guernsey, of Vancouver. It is stated there is 5,000,000 tons of ore blocked out in two main orebodies, averaging 49 per cent sulphur, 42 per cent iron, 2.3 per cent zinc, and slightly less than 1 per cent copper. Gold and silver values amount to $1 a ton.

▶ Consolidated M. & S. is considering the reopening of the Coast Copper mine, near Quatsino on the northwest coast of Vancouver Island. At the southern end of the island the Tyee copper mine, on Mount Sikker, has been reopened. Thirty years ago ore was shipped from this property and the adjoining Lenora, which is included in the present operation, to smelters at Ladysmith and Crofton.

▶ Operation of the 25-ton dry-grinding mill at Ashloo Gold Mines has been resumed after an interruption of three months. W. V. Smitheringale is superintendent. The company is completing a road from Squamish at the head of Howe Sound.

▶ Ore reserves at the Pioneer mine, were increased from 341,372 tons to 597,481 tons during the fiscal year ended March 31, but the average grade fell from 0.518 oz. to 0.425 oz. of gold per ton. Values in the deeper levels, from the 14th down to the 26th, are lower generally than those above the 14th, which have been mined for the past six or seven years. H. T. James is general manager.

▶ Hedley Mascot Gold Mines earned a net profit of $209,530 in 1936. It is estimated by the managing director, R. H. Stewart, of Vancouver, that there is sufficient ore indicated for five years' operation of the 175-ton mill. Costs averaged $6.98 per ton in the first four months of 1937.

▶ Conclusive evidence of the "salting" of diamond-drill cores at Hedley Amalgamated Gold Mines over a period of two years is revealed in the report of the commissioner appointed by the Provincial Government under the Securities Act to investigate the company's affairs. The former president, superintendent, and mine foreman have been arrested on charges of fraud.

▶ In the Sheep Creek camp, in the Nelson district, most encouraging results have been obtained at the Gold Belt, according to Grattan Lynch, engineer in charge, representing North American Mines, Inc., which controls the operation. Oreshoots have been opened in the 1,500 vein at the 1,850 level for the total length of 480 ft., the last averaging more than 1 oz. of gold across a width of 3.8 ft. for a distance of 200 ft.

▶ The improvement in the metal markets last year was reflected in greater production and higher earnings by the Consolidated Mining & Smelting Company of Canada, Ltd. Revenue from the sale of smelter, chemical, and fertilizer products was $28,433,092 and net profit was $6,953,159, of which $6,131,124 was distributed in dividends. A new record in output of lead was established, 365,081,511 lb. being produced. Other products of the reduction plants at Trail, Tadanac, and Warfield were: gold, 69,330 oz.; silver, 8,615,795 oz.; zinc, 251,387,528 lb.; copper, 865,038 lb.; cadmium, 526,034 lb.; bismuth, 360,613 lb.; and fertilizer products, 97,491 tons. Sulphur for the first time was an important product, the amount recovered in the new sulphur dioxide absorption and reduction plants being 3,464 tons. The performance of the plants, the outcome of extensive research in the company's laboratories, was reported by S. G. Blaylock, vice-president and general manager, to have been gratifying. All gases from the zinc plant will now be treated, sulphur being recovered as ammonium sulphate, sulphuric acid, and in elemental form. The maximum daily output of ammonium sulphate was 165 tons. Its quality is excellent and the cost slightly exceeds that of direct production from ammonia and sulphuric acid because of the extra absorption required. As much as 44 tons of pure sulphur has been produced in one day by the first 30-ton plant, which is to be augmented soon by a second unit of the same size.

Yugoslavia

Development at Stantrg Mine Reveals Good Ore

Silver average increasing with depth but zinc content found to be lower—Kopaonik mine will enter production soon

▶ Trepea Mines, Ltd., earned a profit, subject to depreciation and taxation, of £296,728 in the March quarter of 1937, against £263,094 in the preceding quarter. Thus in the first half of its fiscal year it has earned £559,822, which is over 50 per cent on its outstanding capital of £1,117,038, none of which was issued at a higher price than par. The quarterly report states that on the 485-meter level, which is the lowest in the Stantrg mine, "drifting and cross-cutting in ore had developed an area of 2,068 square meters averaging 6.53 per cent lead, 0.18 per cent zinc, 0.21 per cent copper, and 5.30 oz. of silver per ton, of which 1,002 square meters average 9.45 per cent lead, 0.17 per cent zinc, 0.21 per cent copper, and 6.95 oz. silver per ton." Comparison with a previous report reveals that the horizontal area already developed is far larger than on the 545-meter level above, that the percentage of lead is holding up well and that of zinc continuing to decrease, that small amounts of copper are beginning to appear, and that the silver content of the ore has nearly doubled. These changes will appear slowly in the output returns, as approximately six years' supply of ore for the mill is already developed and remaining unmined on the levels above. The increased revenue from silver will probably fully offset the decrease from zinc.

▶ Kopaonik Mines Ltd., will probably begin regular shipments of ore to the Trepea mill in July, the capacity of the mill having been increased for its accommodation. The plant of Zletovo Mines Ltd., is expected to be completed about the end of this year.

Africa

Metal Producers Approve Change in Defense Tax

British government considering revising terms before introducing bill, as base metal producers would pay more than proportionate share — Mufulira plans to mine high-grade orebody

▶ Three letters, N D C, have been featuring the nightmares of British mining interests recently. They stand for National Defence Contribuition, the name of a proposed new tax by which the Government would take a percentage of the increased yearly profits of all British companies. As mining companies, and particularly those producing base metals, have jumped suddenly from relative impoverishment to affluence, such a tax would take far more in proportion from them than from companies engaged in practically all other industries. Protests have caused the Government to declare its intention of revising the terms of the bill before introducing it, and it is believe now that the mining industry will be dealt with justly. If not, it is thought that many mining companies will transfer incorporation to the colonies of their activities. Many of the Witwatersrand mines are incorporated in the Union of South Africa, and thus will escape this tax. The suggestiveness of this to other companies is beginning to be appreciated by the British Government. There is practically no opposition to the principle of the tax; only a desire that it be equitably distributed.

▶ Selection Trust, Ltd., A. Chester Beatty, chairman, made a profit of £434,000 last year, against £119,000 the previous year. It is paying a dividend of 1s. and a bonus of 6d. a share. Its investment holdings are cheifly American Metal, Consolidated African Selection Trust, Trepca Mines, and Roan Antelope, all of which are paying dividends, and Rhodesian Selection Trust, Kopaonik Mines, and Zletovo Mines, which should begin paying dividends this year, next year, and two years hence, respectively.

▶ The higher price of copper enabled Roan Antelope to double its December quarter net earnings in the March quarter. Its profit after an increased allowance for depreciation, £50,000 against £37,500 previously, and a presumably final deduction of £20,000 for debenture interest and premium, was £615,000, as against £307,000 for the December and £174,500 for the September quarters. Thus for the first nine months of its fiscal year Roan Antelope has earned £1,096,500, or over $5,000,000, which is subject only to taxation. As the average price of standard copper was £61 5s. 6d. during the March quarter and Roan's gross income £1,080,500, the amount of copper delivered and paid for was apparently about 17,633 long tons. Roan's productive capacity is about 7,500 long tons of blister copper per month, and its monthly output is probably within 1,000 tons of that now.

▶ Though Mufulira Copper Mines was apparently producing at less than half its capacity in the March quarter, it made a profit of £148,000, after allowances of £20,000 for debenture interest and £25,000 for depreciation. Its mine development is well advanced, but it is probably the plan to mine the upper orebody, of the three which lie close together, more rapidly than the others. Presumably this is the reason that it has not been brought up nearer to capacity in the few months since the curtailment agreement was suspended. A rapid increase of production is to be expected in the immediate future, the upper orebody being of high grade, particularly the part to be mined during the coming several years. The capital of Mufulira Copper Mines is to be reconstructed, for convenience and to make it more representative of the amount of money expended. The 8,539,636 shares of 2s. each will be consolidated into 853,963 shares of £1 each, the capital increased to £5,000,000, in order to capitalize its huge "premium on shares" account, and then three of the new shares will be distributed free of charge for every two shares held. This will make no difference in the proportionate holding of the three companies which own Mufulira—that is, Rhodesian Selection Trust, Rhokana Corporation and British South Africa Company—their proportions remaining at 64.07, 32.30, and 3.63 per cent as at present.

▶ Ariston Gold Mines, in the Gold Coast field, is developing an orebody which was discovered on the seventeenth level. According to L. R. Jackson, general manager, it averages 9.60 dwt. over a width of 342 in. and has been driven on for 1,100 ft. Its position is being approached by drives on other levels.

▶ General Smuts has asked that the representative of the Union of South Africa to a coming British Empire industrial conference make inquiries as to the future of gold as the basis of world currencies. This has provoked discussion which some fear may make funds less readily available, temporarily, for the development and equipment of new gold mines. But few are taking it seriously. European governments generally are striving to increase their gold reserves.

Sovfoto

When it's springtime in the Tundra, smiles are more common around the shaft of the Artemovsky gold mine, in Siberia. Russian officials announced on June 2 that Soviet gold production at the end of the third five-year plan (1942) would be 75 per cent above the second five-year plan that ends this year

RAND LABOR UNIONS

THE "CLOSED SHOP" effective on June 1 has been adopted on all Witwatersrand gold mines. An official statement by the Gold Producers Committee of the Transvaal Chamber of Mines says that a grave situation had arisen at several mines, as serious friction was created among employees by attempts to form a new nationalist trade union in opposition to the existing ones. The Committee, after a section of the workers had gone on strike, announced that with a view to terminating this dangerous state of affairs, and in the belief that the existing unions are sufficiently representive of the interests of the employees, said new unions would not be recognized. The decision of the Committee was acclaimed by large sections of the population, all trade unions, and the Government.

Spain

Rio Tinto Receiving Peseta Credits of Unknown Value

Annual report shows Civil war wiped out profits from company's pyrite production

▶ Though Rio Tinto has again paid the full dividend of 5 per cent on its preference shares, its profit for 1936 was £63,273, against £174,280 in 1935. The civil war made it impossible for it to earn any profit in Spain, though the company has since obtained certain concessions from General Franco's administration, which have eased the situation slightly. Nevertheless, the drain on the sterling resources continues, in place of which the company is accumulating pesetas and peseta credits of unknown value. This unstable situation has promoted more business for pyrite products in Portugal, Scandinavia, Yugoslavia, and other countries, who have secured long-term contracts with customers formerly supplied exclusively by Spanish pyrites. After paying the preference dividend to Rio Tinto carried forward £451,775, and the book value of its investments, £2,894,199, was exceeded by their market value. 87 per cent of the whole being in Rhodesian companies. It will take up at least 425,000 shares of the new Nehanga Consolidated—that is, as many as Rio Tinto has of ordinary shares outstanding. The increased dividend payment on its large holdings of Rhokana Corporation should tide Rio Tinto over the Spanish difficulty satisfactorily.

Australia

Government to Build Railroad to Lake George Mine

Mill of 500 tons' capacity will be constructed—Survey of iron-ore resources under way—New Broken Hill reports some drilling results

▶ It is estimated that £545,000 sterling will be required to open up and equip the Lake George Mine, Captain's Flat, N.S.W., on a basis of treating 500 tons daily for a start, and increasing to 1,000 tons later. Annual profit with lead at £18, zinc £18, copper £40, silver 1s 9d per ounce and gold £7 per ounce is estimated at £202,000 when treating 500 tons daily and £400,000 on the basis of 1,000 tons daily. Erection of the 500-ton unit and preparation of the mine is expected to require eighteen months. The New South Wales Government has agreed to construct a railway line from Bungendore to Captain's Flat (21 miles) to serve the mine. The estimated cost is £160,000.

▶ The Federal Government, it is announced, intends to make a survey of the Commonwealth's iron-ore resources. The information will be used in discussions designed to determine local requirements and export possibilities.

▶ New Broken Hill Consolidated, Ltd., which is developing the Barrier South leases to the south of the property of the Zinc Corporation, Broken Hill, N.S.W., reports the intersection by diamond drill of what is apparently the top of the "Broad lead lode." Where cut, the lode assayed 13.4 per cent lead, 2.6 oz. silver, and 7.8 per cent zinc over a true width of 12½ ft. The whole was drilled from the 1,130-ft. level at an angle of 80 deg. and met the lode at a drilling depth 1,257 ft. below this. If the interpretation is correct, the lode has been encountered at a vertical depth of 400 ft. shallower than anticipated.

▶ Wattle Gully Gold Mine, at Chewton, which is one of Victoria's leading gold producers, reports an important development in a winze below a slide at the 655-ft. level. Insufficient work has been done as yet to enable any estimate of increased tonnage to be made, but indications are promising.

▶ Raub Australian Gold, operating at Raub, Pahang, Malay States, is calling for tenders for a mill to treat 300 tons of tailings a day, of which 130 tons represents current production, and the remainder will be accumulated tailings stacked over many years, of which there is some 300,000 tons averaging 2 dwt. per ton. J. Coldham is general manager.

▶ During the six months to March 31 Mount Lyell, in Queenstown, Tas., treated 411,529 long tons of ore for the production of 6,715 tons of cathode copper. In the corresponding half of the previous year 306,736 tons were treated and copper production was 6,509 tons. Over two-thirds of the total output is now being derived from opencut operations from large low-grade deposits.

▶ The West Australian gold yield for March was 75,183 oz. and the total for the first quarter of 1937, 223,466 oz., an increase of 50,000 oz. over last year's record.

▶ Redbank Alluvial, N.L., has been formed to operate a gold dredge at Redbank, in the Avoca district of Victoria. Minimum yardage is 6,000,000 cu. yd. of 3.5 grains per yard. Total costs are estimated at 4d. per cubic yard and the estimated life of the property is seven years. H. L. Stewart is manager.

▶ Australia's gold yield in 1936 totaled 1,167,162 oz., the highest since 1918. Details by states for this year and last are as follows:

Production in fine ounces	1935	1936
Western Australia	644,875	846,208
Queensland	105,461	115,550
Victoria	87,517	113,950
New South Wales	47,706	60,739
North Australia and others	29,178	30,689
Totals	914,737	1,167,126

▶ Rothsay Gold Mines, N.L., Rothsay, W. A., which suspended operations some time ago owing to treatment difficulties, reports that erection of the remodeled mill is nearing completion and that operations started early in May. This mine is considered to be one of the most promising of the smaller mines of Western Australia. The new mill, which will treat the ore by flotation replaces a battery and cyanidation plant, which gave trouble owing to the presence of copper in the ore.

▶ Wiluna, W. A., announces that the erection of a second blast furnace will start immediately, the completion of which will enable the entire output to be smelted. All smelting and refining operations are now proceeding satisfactorily, except that certain minor difficulties are still experienced in the final stage of the refining process.

▶ Yellowdine Gold development, Yellowdine, W.A., has cut, in a diamond drill hole, the downward continuation of the east lode at a point 70 ft. vertically below the 200-ft. level. Assays averaged 40 dwt. per ton over an estimated true width of 6 ft.

▶ Lancefield, operating at Beria, W. A., has declared its third dividend of 1s. per 4s. share, payable on March 24. With this payment three-quarters of the original subscribed capital will have been returned. During February, 10,299 short tons was treated for a working profit of £15,832 Australian currency.

▶ Thanks to high prices for base metals, prospecting has revived. Discovery of a large lead lode 5 miles northeast of Broken Hill, N. S. W., is reported. A company has been formed to work silver-lead orebodies discovered near Zeedan, Tas., a few years ago but which have lain undeveloped up to now.

▶ A complete survey of the mineral possibilities of the Tennant Creek area, in Central Australia, is to be made by Dr. Woolnough, Commonwealth Government geologist.

▶ Aerial survey of rough country in Cape York Peninsula, northern Queensland, believed to be likely to contain gold deposits, is to be resumed in April by the North Australian Survey Committee.

▶ At the annual meeting of the Australian Mines and Metals Association, held in Melbourne on March 17, the president, Sir Colin Fraser, in the course of his address gave the following metal production statistics:

Abstract of E.E.I. convention paper.	Long Tons
Copper	17,300
Lead	224,000
Zinc	(a)172,500
Tin	4,300
Silver, ounces	12,288,000

(a) Approximately 70,000 tons metallic zinc: remainder shipped as concentrate.

The major development in gold mining he said was the equipping of the Big Bell mine, near Cue, W.A. Illustrating the effect of the price of gold on the grade of ore treated, in Western Australia the average grade has declined from 12.9 dwt. per ton in 1930 to 6.9 dwt. in 1935.

▶ The Trekelano mines, west of Cloncurry, formerly worked by the Hampden Copper Company for copper and gold, has been reopened, and ore is being railed to the Chillagoe Smelters.

Fiji Islands

Cyanide Plant at Loloma Nears Completion

Emperor mine producing about 1,000 oz. gold per month

▶ Ellis Davies, consulting engineer to the Emperor and Loloma companies, operating in Fiji, who has just returned from a trip to the properties, reports that good progress is being made in mill construction at both mines. Unless unforeseen difficulties arise, the Emperor mill which has a capacity of 12,000 tons a month, should be in operation about the end of September, and the Loloma plant, of 500 tons a week minimum capacity, about the end of July. The Emperor mine is at present crushing slightly over 2,000 tons per month for a yield averaging 1,000 oz. of gold. Recent development at the Emperor has proved the lode by means of an internal shaft to a depth of 24 ft. below the No. 2 (190 ft.) level. The ore, which carries tellurides and closely resembles that of the Loloma mine, gave average assays of 20 dwt. ton for the full depth of 24 ft.

PERSONAL ITEMS

C. C. Livingston, of Randsburg, Calif., has gone to Manila, P. I.

F. E. Chaon, recently at Canton, S. D., is at the Rosario Club, San Juancito, Honduras.

A. C. Most, engineer long identified with mine activities in Utah, lately visited several districts in Nevada.

T. W. Page is now general superintendent for Hidden Lake Venture, Inc., near Anaconda, Mont.

H. C. McCloskey has been elected vice-president of Lamaque Mines, Ltd., in western Quebec.

S. Power Warren has joined the staff of Mining Research Corporation, Ltd., 320 Bay St. Toronto.

Percy R. Middleton has become manager of Bindah Gold Mines, Ltd., at Linden, W. A.

W. A. Hughes is now an inspector of mines with the Mines Department of Western Australia.

Lee D. Dougan has opened an office for consulting work at 916 Federal Building, Toronto.

Philip M. Malouf has been made general manager of Scott Chibougamau Mines, Ltd., in western Quebec.

Frank T. M. White has become general manager of Edjudina Gold Mines, at Porphyry, W. A.

J. V. N. Dorr is making his annual trip to Europe. He expects to return about mid-July.

Douglas B. Sterrett has become associated with Vidette Gold Mines, Ltd., at Savona, B. C.

N. E. Nelson is now consulting geologist to the Britannia Mining & Smelting Company, at Britannia Beach, B. C.

U. A. Jurva, formerly of Duluth, Minn., has gone to Colorado, his address there being Box 442, Colorado Springs.

L. K. Jacobsen, mill superintendent of Mount Isa Mines, Ltd., is leaving shortly for an extended visit to the United States.

A. D. Bryant, of the Cerro de Pasco Copper Corporation, Oroya, Peru, is in New York after an absence of seven years.

H. D. Keiser, who was formerly with the United States Geological Survey on mineral leasing work at Miami,

H. D. KEISER

Okla., and resigned in 1927 to join the editorial staff of *Engineering and Mining Journal,* has been reinstated in the Geological Survey as mining engineer and assigned to the Mining Division at Washington, D. C.

Wolfram Penseler, of New Zealand, has been made manager of Asam Kumbang Tin Dredging, Ltd., at Taiping, F. M. S.

J. B. Knaebel has resigned as manager of East Mindanao Mining Company, Philippine Islands, and has been succeeded by **John Smeddle.**

J. K. Wadley, mine operator of Texarkana, Ark., lately inspected properties he has acquired in three Nevada districts.

W. H. Coghill, supervising engineer, Mississippi Valley Experiment Station, Rolla, Mo., spent the last week in May in the Tri-State district.

I. W. Morley, formerly with Mount Kasi Mines, Ltd., in Fiji, has joined the staff of Wiluna Mines Ltd., at Wiluna, W. A.

Leo Joseph Jones has been appointed government geologist of the New South Wales Department of Mines, succeeding **L. F. Harper.**

V. G. Martin has resigned from his position as manager of Edjudina Gold Mining Company, N. L., at Yarri, W. A.

H. Gasser, executive head of the East Mindanao Mining Company, Philippine Islands, is taking a vacation at St. Gallen, Switzerland.

H. G. Walker, engineer, of Reno, has returned from New York, where he helped to secure funds for construction of a tungsten mill.

Walter E. Trent, heading several mining organizations in Nevada and California, has been in Reno from his headquarters near Mojave.

Mark Bradshaw, president of the Bradshaw Syndicate, Inc., expects to sail for the Philippine Islands soon, to examine mining property.

R. A. M. Mackay has left Tanganyika to take up a study of the Lupa gold areas under a Colonial Grant from the Carnegie Corporation.

W. R. Edmondson has taken a position as assistant mine master mechanic with the Cananea Consolidated Copper Company at Cananea, Sonora, Mexico.

Rensselaer Toll, mining engineer, of Los Angeles, is in Seattle Wash., on business, following professional work in northern California.

E. H. McMurray has been visiting Nevada points from Mojave, Calif., where he has been producing from a lease on the Whitmore mine.

Erich J. Schrader, consulting engineer of Reno, has returned to his home from professional trips to Utah and Arizona districts.

Homer L. Gibson, executive head of the Dayton Consolidated Mines Company at Silver City, Nev., has returned to the mine from Arizona.

Major J. Paul Jones has assumed management of the mine and enlarged mill of the Operator Consolidated Mines Company at Randsburg, Calif.

William Sharp, field engineer for the Tonopah Mining Company, has been inspecting a gold property in Elko County, Nev.

Lou M. Louis, construction engineer, who has built a number of mills in Nevada and other mining states, has been at Grass Valley, Calif.

T. S. Mackay, recently assistant manager at the Premier mine, at Anyox, B. C., has joined the staff of Big Bell mine at Cue, W. A.

J. Cornelius, formerly metallurgist at Mount Coolon Gold Mines, has been appointed metallurgist to Gold Mines of Kalgoorlie.

Dr. Hans Pirow, Government Engineer to the Union of South Africa, resigned his post on April 30. The resignation became effective on May 22.

Dr. Cyril Fox will represent the Government of India at the seventeenth International Geological Congress to be held in Moscow next month.

John C. Rogers and **E. K. Fockler,** mining geologists, have moved their offices from the Concourse Building to the Victory Building, Toronto.

S. R. Brown, mining engineer for the Union Corporation, Ltd., is making an extensive visit to China in mine examination work.

Ellis Davies, consulting engineer to the Emperor and Toloma companies, in the Fiji Islands, has returned to Melbourne following a trip to the mines.

Harlowe Hardinge, vice-president and general manager of Hardinge Company, Inc., is on a trip to the Pacific Coast.

Bailey Willis is making a reconnaissance of northern Luzon as guest geologist to the Bureau of Science and Mines in the Philippine Islands.

Floyd L. Greene was recently elected president of the General Refractories Company. Mr. Greene has been actively identified with the refractories industry for 25 years.

H. P. Dickey, recently with Howey Gold Mines, has accepted a post with Gold Eagle Gold Mines, Ltd., at that company's McKenzie Island property in the Red Lake district of Ontario.

Jesse L. Maury has resigned from the staff of the Securities and Exchange Commission at Washington, D. C., to accept a position with the Lehman Corporation at 1 South st., New York City.

E. V. Gent, secretary of the American Zinc Institute, spent a week in the Tri-State district following the annual meeting of the Institute in St. Louis.

Clark Henry, who recently resigned his position as village engineer at Hibbing, Minn., is now employed by C. K. Quinn & Company at the Shada mine, at Nashwauk, Minn.

A. I. George has returned to the plant of the Ashanti Goldfields Corporation, Ltd., at Obuasi, Gold Coast Colony, West Africa, as mine captain, after a nine months' tour.

C. O. Stee, manager of Siscoe Gold Mines, Ltd., has been engaged as a consulting engineer to assist in the development of Jacola Gold Mines and Siscoe Extension, in western Quebec.

D. N. Matheson, recently general manager of Minto Gold Mines, Ltd., has resigned from his post to become general superintendent of Bralorne Mines, Ltd., at Bralorne, B. C.

A. D. Robinson, recently manager in Western Australia for Australian Mining Trust Ltd., has been made manager of the Rothsay gold mine, near Perenjori, W. A.

R. E. Legg, who has represented the N. A. Timmins Corporation of Toronto in British Columbia for several years, has removed to Fondulac, Lake Athabasca, to direct the prospecting operations of his principals there.

Captain C. E. Temperley, O. B. E., M. C., one of the managers of Union Corporation, Ltd., was a recent visitor to New York, spending part of his vacation in the United States.

E. A. Strout, general manager of San Francisco Mines of Mexico, Ltd., concluded a business trip to New York City in May and returned to his office in El Paso, Tex.

W. Earle Grenough, well-known Coeur d'Alene district mining engineer, has returned to his home in Mullan after spending eighteen months in southwestern Oregon installing milling equipment at the Benton mine.

E. O. Sowerwine has been made assistant to the president of Anaconda Copper Mining Company; **James Dickson** has been appointed comptroller and **W. K. Daly** becomes general auditor. Announcement of these appointments follows a recent meeting of the board of directors of the company.

Horace Lackey, manager for the Ambassador Gold Mining Company in Lyon County, Nev., has acquired a gold property in the Happy Creek district, in northern Humboldt County, in the same State.

John E. Hammell, who has become a national institution in prospecting in the North and the development of Canadian mining enterprises, has taken over the nine-claim group of McIntyre Porcupine Mines at Red Lake, in the Patricia district of Ontario. According to report, he will develop the property

Ashley and Crippen

JOHN E. HAMMELL

with his own resources. An extensive exploration with diamond drills and surface work is in prospect. The property consists of 389.2 acres. It is near the town of Howey. **Ben H. Budgeon,** director of mining for the Hammell interests, will have general direction of developments. A biographical sketch of Mr. Hammell and a record of his conspicuous part in the discovery and development of Canadian mines was presented in the November, 1935, issue of *Engineering and Mining Journal.*

Walter H. Parker, professor of mining at the University of Minnesota, is making a tour of mining properties in South Dakota, Colorado, and Utah with a group of junior students in mining engineering.

J. M. White, formerly manager of Takuapa Valley Tin Dredging Company, has assumed charge of the sluicing operations of Avoca Developments, N. L., on the Malakoff property at Landsborough in Victoria, Australia.

Hugh M. Wolflin, formerly mine inspector for the Industrial Accident Commission, is now in Grass Valley, Calif., in charge of personnel and safety for the Idaho Maryland Mines Corporation.

P. E. Clarke has taken charge of operations at Morning Star Mines, at Woods Point, Vic., in place of **E. Williams,** who resigned to accept the position of manager of North Wattle Gullie Gold Mines, N. L., at Chewton, Vic.

E. N. Pennebaker, chief geologist for the Consolidated Coppermines Corporation at Kimberly, Nev., is in charge of a field party of students of the Mackay School of Mines on a three months' motor trip to include widely scattered mining districts in the State.

H. R. Plate, who has been making headquarters in San Francisco, has been appointed consulting engineer for the Hartford Mining Company, operating a gold mine and cyanide mill below Gold Hill, Nev.

D. H. Bell, of the staff of Gold Mines of Australia, Ltd., recently returned to Melbourne after some months in South Africa, where he made a particular study of the manufacture, shop treatment, and use of rock-drill steel.

Cornelius F. Kelley, president of Anaconda Copper Mining Company, and **Carl T. Ulrich,** vice-president of Kennecott Copper Corporation, sailed on the "Normandie" on May 19 for London.

Richard Tarantous, mining engineer, is supervising the erection of a milling plant for Libby Gold Mines, Inc., which has acquired the property of the Tip Top company at Bramlet Creek, south of Libby, in Lincoln County, Mont.

S. F. Hunt, geologist and discoverer of the Rio Tinto mine of the Mountain City Copper Company, attended commencement ceremonies at the University of Nevada. He has made notable benefactions to the Mackay School of Mines, a department of the Nevada university.

Ing. Javier Sanchez Mejorada has been elected president; **Lic. Eduardo Prieto Lopez,** secretary; and **Ing. Faustino Roel,** treasurer, of the newly organized National Mining Chamber of Commerce of Mexico.

Henry Ross Taylor has resigned as mill superintendent of Granby Consolidated Mining, Smelting & Power Company to accept a position with the Nevada Consolidated Copper Company, at the Chino Mines Division in Hurley, N. M.

R. C. Allen, president of A.I.M.E., visited Joplin, Mo., on May 1. He was accompanied by **A. B. Parsons,** secretary of the Institute, and **Dr. H. A. Buehler,** Missouri State Geologist and past president of the Institute.

Hugh W. Coke has been transferred from the Tybo plant of the Treadwell Yukon Company, Ltd., where he held the position of mill superintendent, to Juneau, Alaska, where he will do some metallurgical work at the Alaska Juneau mill.

Stanley Walker, mining engineer, of Denver, Colo., was recently appointed superintendent of Lakeside Monarch Mining Company. He was formerly manager of Monarch Madonna Mine, at Salina, Colo., and for several years superintendent at the National Lead Company plant at Rico, in southwestern Colorado.

E. W. Engelmann, superintendent at the Utah Copper Company's Magna plant, has been elected chairman of the Utah Chapter of the A.I.M.E. **W. R. Landwehr,** geologist with American Smelting & Refining Company, is vice-

chairman, and **G. L. Oldright,** United States Bureau of Mines supervising engineer, is secretary.

William C. Madge, formerly with the Tintic Standard Company and earlier on the Bewick, Moreing & Company staff, has assumed management of the mine and 200-ton flotation mill of the Sierra Nevada, Ltd., on the Comstock lode.

Lucien Eaton is at Painesdale, Mich., where he is consulting engineer for the Copper Range Company and the Isle Royale Copper Company. The latter is preparing to unwater the Isle Royale mine, which has been closed for five years.

Michael C. Carosella has resigned his position as night superintendent of Cripple Creek Milling Company, at Cripple Creek, Colo., to accept a position in the laboratory of Harley A. Sill, consulting engineer. His address is 1011 South Figueroa St., Los Angeles, Calif.

F. W. Gray, a former Editor of *Canadian Mining Journal* and prominently identified for many years with Canadian professional mining organizations, received the honorary degree of doctor of laws from Dalhousie University on May 11.

Sir Herbert Gepp, director of the North Australia Aërial and Geological Survey, has returned to Melbourne following a four weeks' tour of inspection of the more promising deposits investigated by the survey in North Queensland, the Northern Territory, and Western Australia.

A. E. Cave, formerly an engineer at the Garson mine of the International Nickel Company, has been appointed Inspector of Mines in the Kenora and Red Lake regions by the Ontario Department of Mines. His headquarters will be at Kenora, Ontario.

Walter A. RuKeyser is engaged in consulting engineering at 70 Pine St., New York City, acting in that capacity for Montague Gold Mines, Ltd.; Waverly Consolidated Gold Mines, Ltd.; Tashota Goldfields Ltd.; St. Stephens Nickel-Copper property; and the Maruba Corporation. His Montreal address is at IIII Aldred Building.

A. O. Stewart has been elected chairman of the board of Anglo American Mining Corporation, Ltd. **Walter Lyman Brown** has been made president of the Corporation; **Henry W. Klipstein,** executive vice-president and treasurer; **John N. Rosekrans,** vice-president; and **L. M. Davis,** secretary.

T. R. Oberman, a director of the Cortez-King Brand Mines Company, has been elected president of the company to succeed his father, D. M. Oberman, who died on Feb. 27, 1937. **Francis Roer** was named temporary secretary-treasurer to succeed **H. B. Church, Jr.,** who died March 13, 1937.

N. I. Haszard has joined the staff of Wiluna Mines, Ltd. He was the holder of the North American Cyanamid Research Scholarship in 1936 and carried out research work in the metallurgical department of the University of Melbourne, on the treatment of ore and concentrates from Lake View & Star mine, at Kalgoorlie, W. A.

Dr. Frederick Mark Becket, president of the Union Carbide and Carbon Research Laboratories, Inc., and vice-president of the Electro Metallurgical Company and the Union Carbide Company, has been awarded the Acheson Medal and $1,000 prize by the Electrochemical Society for his outstanding contributions to electrometallurgy.

George C. Lipsey, formerly assistant mine superintendent of Britannia Mining & Smelting Company, Ltd., in British Columbia, has been appointed general superintendent of Chelan Copper Mining Co. at Lucerne, Wash., where a 1,000-ton concentrator is under construction. Both companies are subsidiaries of the Howe Sound Company.

Frank Ebbutt, geologist and field engineer for the Britannia Mining & Smelting Company, Ltd., at Britannia Beach. B. C., for the past thirteen years, has been transferred to eastern Canada, where he will be engaged in exploratory and examination work for the Howe Sound Co., of which the Britannia is a subsidiary. His headquarters will be in Toronto.

Dr. William Bowie, of the United States Coast and Geodetic Survey (retired), of Washington, D. C., has been awarded the Elliott Cresson Medal, by the Franklin Institute of Philadelphia, "In consideration of his contributions to the science of geodesy, particularly with reference to the theory of isostasy, the application of which he has extended to problems in general geophysics and geology."

E. A. Loring, with his wife and daughter, recently passed through Virginia City, Nev., on their way to London from Australia. Mr. Loring is the son of W. J. Loring, president and managing director of the Arizona Comstock Corporation, and he succeeded his father as a partner in Bewick, Moreing & Company, of London.

H. H. Montgomery has been retained as resident engineer and geologist for the American Rand Corporation. This company has completed its new 33,000-volt power line connecting with the main trunk line of the Washington Water Power Company south of Oroville, Wash. He is now at the property at Wannacut Lake, supervising improvements to the company's milling plant.

M. D. Harbaugh spent several days in the Tri-State district the latter part of May when he returned to move his family to Cleveland. Mr. Harbaugh resigned as secretary of the Tri-State Zinc and Lead Ore Producers Association on Jan. 1, 1937, to accept the position of vice-president with the Lake Superior Iron Ore Association at Cleveland. The Tri-State Section of the A.I.M.E. gave Mr. Harbaugh a farewell dinner on the night of May 22, at which time he was presented with a watch, a memento from his many friends in the district.

OBITUARY

Frank M. Smith, director of the Bunker Hill Smelter, at Kellogg, Idaho, died on June 1 at his home in Spokane. He had retired from active work in 1935.

Frederick Charles Cann, manager of Geevor Tin Mines, Ltd., at Pendeen, Cornwall, for the last seventeen years, and a director in the company, died recently at the age of 58.

Peter MacLaren, prominent as an authority on the geology of Ontario mineral regions in the early days of mining in the province, especially in the Porcupine camp, died recently in Scotland.

John S. Lutes, who had been general manager of mines for the Tod Stambaugh Company, formerly an independent iron-ore producer in the Lake Superior mining district, where he was widely known, died at Pasadena Calif., on May 5.

Clarence A. Corry, foreman of the Sunrise gold mine, near Philipsburg, Mont., was instantly killed recently in a mine-shaft accident. He was 30 years old. Mr. Corry was graduated from Montana School of Mines, and had been employed by the Sunrise company for several years.

William H. Brandon, veteran Canadian prospector and mining man, died on May 1 last. Mr. Brandon discovered the potentialities of the Kootenay Lake district, which he developed. The town of Brandon, B. C., was named after him.

John Albert Dennison, who since 1905 had been consulting engineer in London to the Anglo-French Exploration Company, died recently at the age of 64. He was a member of the Council of the Institution of Mining and Metallurgy.

Walter George Perkins died on May 1 at the age of 67. Mr. Perkins had been associated with Granby, Nevada Consolidated, and Tanganyika Concessions, and had done professional work, also, in Russia, the Argentine, and Korea. He was associated with Minerals Separation prior to his retirement some years ago.

Capt. J. H. Rough of Negaunee, Mich., father of James H. Rough, Jr., of Hibbing, Minn., died here May 20. Captain Rough was underground superintendent of mines for the Cleveland-Cliffs Iron Company for a great many years. He retired several years ago. James H. Rough, Jr., is village engineer of Hibbing, Minn.

NEW BOOKS

MINE ECONOMICS: SAMPLING, VALUATION, AND ORGANIZATION. *By S. J. Truscott. Associate Royal School of Mines; D.Sc. University of the Witwatersrand. Cloth, octavo. Pp. 335, illustrated. London: Mining Publications, Ltd. 1936. Price 31s.*

THE AUTHOR of this excellent book writes with the authority of experience acquired during a broad and varied career comprising more than twenty years of exploration and mine operation in Malaya, the Transvaal, Siberia, Borneo, West Africa, and Sumatra. With this splendid background he was, in 1913, called to the chair of mining at the Royal School of Mines.

The first nine chapters comprise 137 pages describing various methods of sampling of metal mines and mineral deposits; the text gives abundant detail supplemented by good illustrations of many diverse examples. Painstaking attention is given to procedures whereby sampling results are intrepreted by consideration of mass density, computations of quantities of ore and of average analyses, and studies of reliability of sampling, including "frequency" methods of computation of probable value and estimate of ore reserves. After all data are assembled, warning is given of possible sources of error; first, probable error of the average, and second, possible error due to bias in taking samples. The author makes distinction between "domestic" sampling for systematic control of operations, and "independent" sampling, commonly involving purchase or sale of the property, wherein the examining engineer must make the study for himself, or, at least, make his own confirmatory observations.

Borehole sampling from surface is adequately treated, with discussion of mapping the area, spacing the holes, sampling the sludge and core, and computation of reserves and average value. Descriptions are given of the sampling of alluvial tin deposits in Malaya and of gold gravels in California by means of boreholes, and of tin in Nigeria by means of pits. Results, reliability, and costs are cited.

The subject of valuation occupies 40 pages of text; here the author is on familiar ground, discussing definition of reserves, consideration of methods of treatment, recoveries, and operating costs. Then follows, in order, the problem of marketing, of ore contracts, specifications and stated tariffs, of life of property, and of the valuation computation according to standard practice. This part of the book closes with six pages having to do with promotions, professional mining reports, and rules of propriety relative to statements made for publication in the prospectus of a public company. "Organization" is the heading of the next 100 pages, which deals with company structure, capitalization, and financing according to British practice. "Management" and organization of personnel are illustrated by charts whereby contrast is had respectively of coal mining in Great Britain and in the United States, and of gold mining in the Witwatersrand and in the United States.

An "Appendix" comprises twelve selected but typical Mining Company Balance Sheets and Profit-and-Loss Accounts. The products represented are gold, lead-silver, copper, zinc, tin, and coal. Annuity tables and an index conclude the book.

W. SPENCER HUTCHINSON

INTRODUCTION TO THE STUDY OF MINERALS. Third edition. *By Austin F. Rogers. McGraw-Hill Book Company, New York, N. Y. 610 Pp., 6x9; 730 figures. Price, $5.*

PREVIOUS EDITIONS of this well-known standard mineralogical text were published in 1912 and 1921. The first two editions were printed in pocket size, but the latest edition is in full textbook size and approximately 100 more pages are included than were in the last edition of 1921. The book presents a most pleasing appearance, covering the description of 220 minerals and mineraloids in a concise, understandable, and up-to-date manner.

The section on geometrical crystallography appears to have received the author's special attention on revision and represents a careful analysis of recent trends of development of the subject. The system of nomenclature is worthy of more general use and it is hoped will gradually supplement the more cumbersome and less systematic nomenclature used in many instances at the present time. On the whole, the book is well written and reasonably free from errors. A few have slipped in, however, and perhaps should be pointed out. On page 127 the Greek letter lambda is omitted from Bragg's equation. On page 268, in mentioning the Louisiana sulphur deposits, the author speaks of dissolving sulphur in superheated steam. Also, the stereographic projection is attributed to Neumann in 1823, although according to Hutchinson the use of the stereographic projection dates from the time of Ptolemy and was even used by his Greek predecessor Hipparchus.

The author is to be commended for including the French and German names for common minerals and also for including directions for the pronunciation of mineral names.

The various mineral properties are given in a conveniently organized form and it is particularly useful to have the optical properties as accessible as they appear in the text. The section on microchemistry written by Dr. Lloyd W. Staples will also be found useful.

It is certain that this text will continue to hold its place among the group of leading mineralogical textbooks in the United States. It will also be found useful as a mineral guide book.

PAUL F. KERR

PUBLICATIONS

RECEIVED

✦ *Ward's Australian Investors' Handbook.* Compiled to Jan. 31, 1937. Issued by Ward & Co., 383 Collins St., Melbourne, Australia.

✦ *Geology of the Silver City District and the Southern Portion of the Comstock Lode, Nevada.* By V. P. Gianella, University of Nevada Bulletin, Vol. XXX, No. 9. Reno, Nev. Pp. 108. Price $1.

✦ *The Skellefte District, Northern Sweden.* A review of the geology and ore deposits. By A. Högbom. Written in Swedish. Pp. 94, with a 24-pp. summary in English. Swedish Geological Survey, Stockholm. Price 6 kr.

✦ *Bibliography of South African Geology, 1931 to 1935 inclusive.* Memoir No. 30. Geological Survey, Union of South Africa, Pretoria. Pp. 168. Price 5s.

✦ *Strontium Minerals* (Second Edition). By E. H. Beard. Imperial Institute, South Kensington, London, S.W.7, England. Pp. 33. Price 1s. 6d. net.

✦ *Mining Methods at Carson Hill Mine, California.* By John A. Burgess. Information Circular 6940, U. S. Bureau of Mines, Washington, D. C. Pp. 15.

✦ *Manual of Philippine Mines.* R. Keeler, Box 769, Manila, P. I. A pocket hand book of active mining companies, giving condensed data on organization, properties, operations, production; also information on the Philippine mining industry. Pp. 53. Price 50c. U. S. currency.

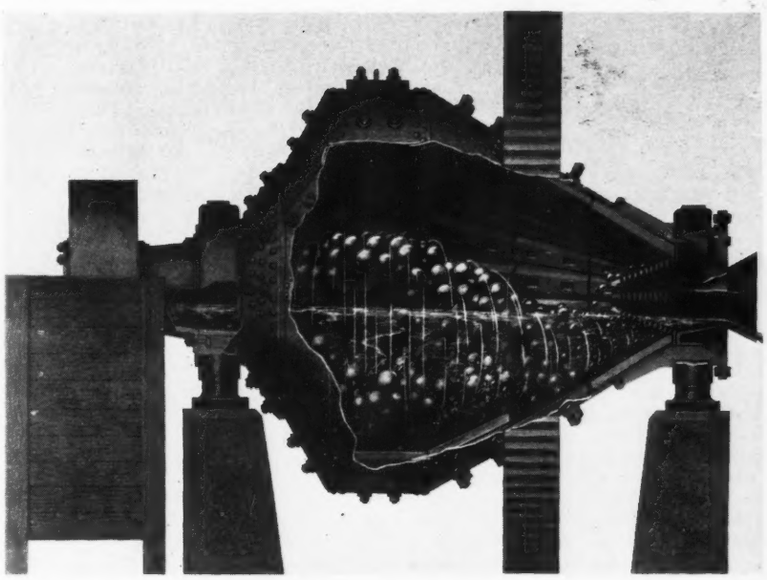
✦ *Securities Act—Act Creating the Bureau of Mines—The Mining Act.* First National Assembly, Philippine Islands. Bureau of Printing, Manila, P. I. Pp. 61.

✦ *Geology and Ore Deposits of the Ajo Quadrangle, Arizona.* By James Gilluly. Arizona Bureau of Mines, Geological Series No. 9, Bulletin 141. Pp. 83, with maps.

✦ *Upper Copper and Tanana Rivers, Alaska.* By Fred H. Moffit. Bulletin 868-C, U. S. Geological Survey, Washington, D. C. Pp. 135-142 inclusive, with a map. Price 10c.

✦ *Non-metallic Mineral Resources of New Mexico and Their Economic Features (exclusive of fuels).* By S. B. Talmage and T. P. Wootton. Bulletin 12. New Mexico Bureau of Mines, Socorro, N. M. Pp. 158.

EQUIPMENT NEWS

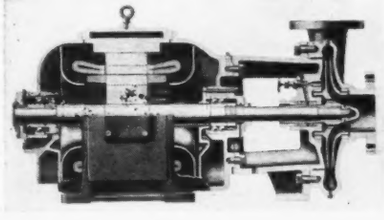


Improved Mill Discharge

HARDINGE COMPANY, York, Pa., announces the Reverse Cone Grate and High Pulp Level Discharge, a new development in mill design that simplifies construction and increases over-all efficiency. Formerly, standard construction of the mill for wet-grinding purposes incorporated an outward facing ball retainer grate and trunnion opening the same size as the inside diameter of the open discharge trunnion. By reversing the grate, as shown in the picture, so that it faces inward, and by increasing the pulp level by use of a much smaller pulp-level discharge spout, or bell, the old pulp level within the mill is raised considerably. The action of the reverse cone grate keeps the small balls or tramp oversize within the mill. When balls or tramp oversize crowd into the apex of the cone, this crowding tends to raise the mass on the top of the grate, and it falls back into the mill, thus keeping the grate absolutely free. As the grate is at the discharge end of the mill, where there is no cascading action, wear is said to be negligible. Raising the pulp level is said to have increased the over-all capacity 8 to 9 per cent over previous operations, with power remaining constant. Ball and liner wear figured on a basis of cost per ton is also said to be correspondingly reduced. The high pulp level discharge is much easier to close circuit with the standard classifier, without having to employ excessive sizes and diameters of scoops. The cone grate and high pulp level discharge is so designed that it may be incorporated on all standard modern-type Hardinge mills, now in use, and the device is part of standard equipment on all new Hardinge mills being manufactured by the company for use in wet grinding.

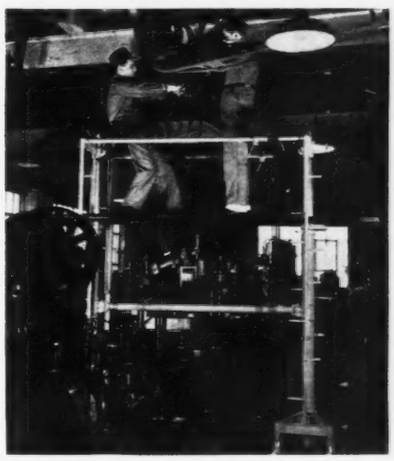
Motor-Mounted Pump

A NEW LINE of motor-driven centrifugal pumps for capacities of from 5 to 1,200 g.p.m. and heads of 10 to 230 ft. is announced by the De Laval Steam Turbine Company, Trenton, N. J. The pump is mounted upon the end bell of an electric motor, with two forming a compact and self-contained unit, with only one shaft and two bearings. A motor-mounted pump is shipped ready for immediate connection to piping and power-supply line and can be installed with the shaft horizontal, vertical, or inclined, or it is said the unit can be mounted upon a hand truck or suspended from a sling. The pump casing is of cast iron, and the impeller, wearing ring, shaft sleeve, stuffing-box gland, and lantern ring are of bronze. Pump parts can be removed without disturbing the motor.



Hydraulic Scaffold

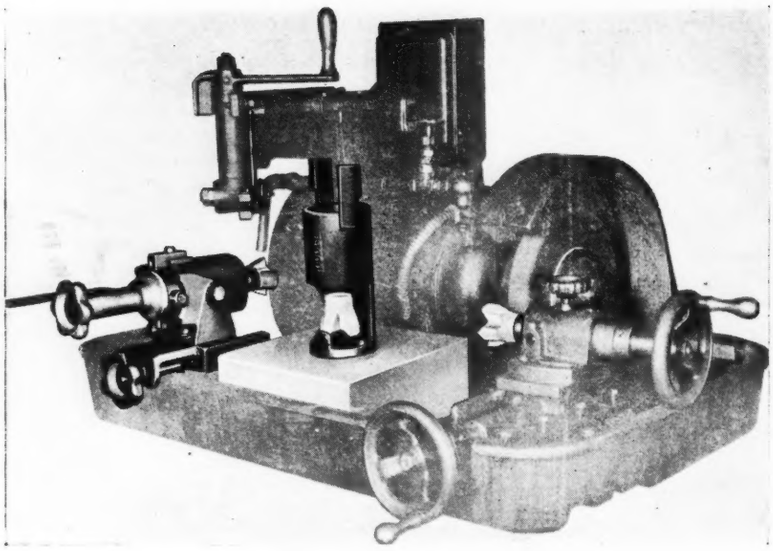
DECOVATOR SCAFFOLDING Corporation, of 2988 East Grand Boulevard, Detroit, Mich., announces a demountable hydraulic scaffold that may be raised, lowered, extended or contracted, and driven from one vantage point to another by mechanical means actuated from the working platform. The new scaffold, called "DecoVator," is said to be made entirely of steel; it is light in weight and its parts are easily disassembled and transported for quick assembly at distant jobs. Assembled, the scaffold provides its own ladder as well as benches for tools and materials and the complete lifting and traveling mechanism. The "reach" of the hydraulically raised and lowered platform is considerable; one model is from 2 ft. 8 in. in the lowest position to a height that will enable a man to work comfortably up to 16 ft. For a second model the low point is 3 ft. 2 in. and men can service



work up to 22 ft. high. The platform is elevated by the worker upon it at the rate of 8 ft. per minute, and lowered at 10 ft. per minute. The entire scaffold structure, which comes with rubber-tired wheels, may be jockeyed from above, in any direction, at a ground speed of 50 ft. per minute.

Feed-Water Level Control

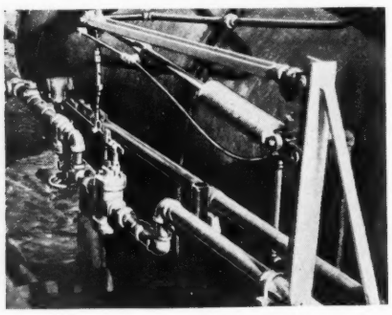
J. A. CAMPBELL COMPANY, Box 851, Long Beach, Calif., announces a new feed-water level control with sensitivity to maintain levels within ½ in., known as the Campbell-Cantilever boiler feed-water level controller. It is made in one size to meet all boiler needs and will operate any valve up to 12 in. Its overall length is 48 in., and it can be operated with or without a whistle. A different mounting is provided for return tubular and water-tube boilers. The frame is set so that the water-level mark is at the same level as the desired water level in the column. When the water level drops in the gage glass, water runs down an inclined tube, exposing it to the high temperature of the steam at



Bit-Grinding Attachment

SULLIVAN MACHINERY COMPANY, Claremont, N. H., announces the new Sullivan detachable bit-grinding attachments for use on the various types of detachable bit grinders now on the market. The Sullivan detachable bit with the unusual design of broad chopping or reaming edges and single cutting edge necessitates a different grinding method from that used on the conventional detachable bit. The new attachment consists of a holder for loading, a barrel with an expansion collet for gripping the bit, and a rocking sleeve mounted on an adjustable base. Alignment is secured by the cutting edges of bit resting between two bars of the loading fixture and bit holder inserted in the loading casing. The alignment is said to be automatic; as the expansion collet tightens to grip the bit, the holder slips into alignment stops. The holder is then inserted into the rocking sleeve with rocker rolls contacting the radial cams while a dowel pin fits into groove on the sleeve to insure true grinding. A rocking of the holder grinds the reaming edge and one side of the cutting edge. The rocker rolls are said to contact the radial cams during the entire grinding operation, so that the bit is in proper contact with the grinding wheel to produce a straight cutting edge. The holder is then revolved 180 deg. and the same operation is repeated and the bit is ground. The gage is ground by the same method utilized on the various types of machines.

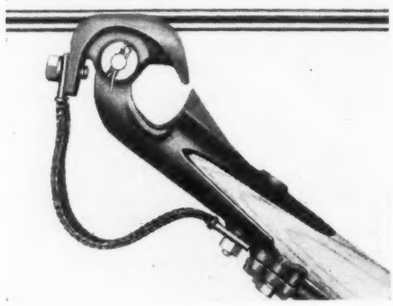
boiler pressure. This instantly causes rapid expansion, which causes the end casting to move upward and opens the valve an amount equal to eight times



the extent of the expansion. If the water rises in the gage, the cooling action of the cool water rising in the tube causes contraction, which lowers the end casting and closes the valve by an amount equal to eight times the contraction. This multiplied principle of contraction and expansion assures sensitive regulation heretofore not available, according to the designer. The action is said to be automatic and requires no manual operation or attention from the boilerman. As an extra safety measure, either a whistle or an electric signaling device can be attached.

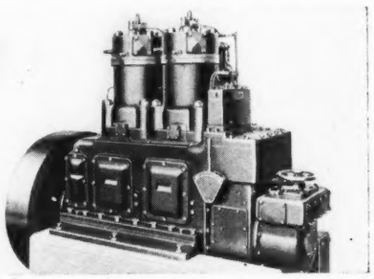
Trolley Slider

THE MOSEBACH Electric & Supply Company, Pittsburgh, Pa., recently introduced a new Wobbler type bronze slider, which is said to have certain advantages over trolley wheels when used on locomotives for main haulage. The manufacturer says the principal advantages are that the slider has more contact area against the trolley wire, it is exceptionally light in weight and, because of its unusual flexibility, it will follow the trolley wire at all times regardless of irregularities or turns in the wire. The pole head and harp is a single, rigid bronze casting. Alignment is said to be taken care of by a swivel in the slider. The shoe is pivoted on a ½-in. axle and is free to move from right to left at the slightest irregularities in the wire. This new slider contains no alignment springs and is said to have fewer working parts than other sliders now available.



New Heavy-Duty Diesel

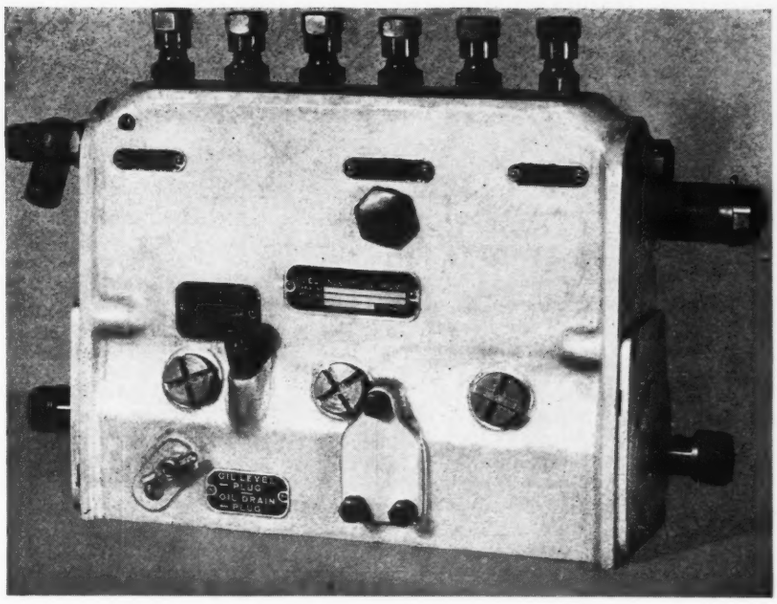
A NEW DIESEL MODEL has been developed by Fairbanks, Morse & Company, 900 South Wabash, Chicago, Ill., to meet the demand of small power users for a heavy-duty, continuous-service stationary engine. It is known as Model 42 E and is available in two- and three-cylinder combinations with ratings of 60 and 90 hp. at 450 r.p.m., and can be furnished for direct-connected, belt, or electric generator drive. With an 8¾-in. bore and 10½-in. stroke, this diesel is smaller and lighter than the F-M Model 32-E, but it is said to embody all of the proved features that have led to the daily use of several hundred thousand horsepower of the larger engines. It is



said to be small enough to be installed where space and headroom are limited, and to be applicable for any power requirement within its horsepower ratings. Two important principles, direct airless injection of fuel and two-cycle design with crankcase scavenging, are said to result in use of an absolute minimum of moving parts. The power impulse on each downward stroke assures a uniform output without need for an abnormally large flywheel. Cylinder heads are simplified by the elimination of air inlet and exhaust valves, with their attendant operating mechanism. The engines are said to be conservatively rated as to capacity, piston speed, and bearing pressures.

Fuel-Injection Pump For Diesels

MEETING THE DEMAND for a dependable high-speed solid injection fuel pump for diesel engines, the Timken Roller Bearing Company, of Canton, Ohio, has announced two sizes of multiple unit, integral camshaft pumps, one using a 4-9 mm. range of plunger sizes and the second a 5-11 mm. range. At present these pumps are being made for one-, two-, and six-cylinder engines. The pumps are of the cam-operated helical-plunger type, the metering being adjusted at the factory and sealed. At



the lowest position of the plunger the cylinder receives a charge of oil from the feed line, which is kept filled by a special feed pump connected to the fuel tank.

Delivery of the fuel to the engine starts as soon as the piston covers the inlet port and ends when the upper helical edge of the annular groove in the piston opens the overflow or bypass port on the opposite side of the pump cyinder wall, releasing the pressure to the discharge line. The effective delivery stroke of the piston may be regulated by turning the piston in its cylinder or barrel to vary the point of the delivery stroke in which the overflow port is uncovered.

A feature of these pumps is that they are driven by constant-velocity cams. Thus the delivery speed of the fuel entering the combustion chamber of the engine is said to be maintained constantly at a speed adapted to the rate of combustion. The deceleration portion of the motion comes late in the stroke, thus permitting the use of a lighter spring and reducing the spring load between the tappet and the cam.

For adjusting the pistons to vary the amount of fuel delivered, a simple and positive method is said to have been devised, comprising a rack rod which extends horizontally along the rear face of the pumps, meshing with precision-cut gears on the upper ends of the driving sleeves. The upper or driving sleeve for each piston may thus be rotated on the barrel of the pump. The Type A, or small-size pump, using a 4-9 mm. range of plungers, is adapted for use on diesel engines up to approximately 150 hp. and operates at speeds up to approximately 4,000 r.p.m. The B size, using a 5-11 mm. range of plungers, is ordinarily used on engines of from 110 to 250 hp., operating at speeds of approximately 3,000 r.p.m.

INDUSTRIAL NOTES

Homestead Valve Manufacturing Company announces the appointment of the following exclusive representatives for the sale of the company's complete line of quarter-turn plug valves, protected seat hydraulic operating, and boiler blow-off valves: Warren Bruce & Company, 3908 Olive St., St. Louis, Mo., and Proctor Engineering Company, Inc., 106 Key Highway, Baltimore, Md.

Sullivan Machinery Company announces that John C. Curtis, formerly chief engineer of the Cleveland Rock Drill Company, has joined the engineering staff of the rock drill division. Mr. Curtis assumes the duties of chief engineer, succeeding Arthur R. Hosking, who is now assistant manager of the division.

Canadian Fairbanks-Morse Company, Ltd., of Montreal, Toronto, Quebec, and twelve other offices in Canada, has been appointed selling agent for Traylor equipment in all of the Dominion of Canada except the Province of British Columbia, and for Newfoundland.

E. D. Bullard Company, manufacturers of safety equipment for mines and industry, has enlarged its Salt Lake City office and is now located at 14 Post Office Place in that city. The Chicago office of the company is now at 133 N. Sacramento Blvd.

Frank Samuel & Company, Inc., metal importers and exporters, are now located at 40 Exchange Place, New York City. H. P. Banks is manager.

C. C. Jordan, sales engineer for the past ten years in the Steam Turbine Division, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has been appointed assistant manager of that division.

BULLETINS

Detachable Meters. Westinghouse Electric Manufacturing Co., East Pittsburgh, Pa. Catalog Section 42-210, describing the new line of polyphase detachable meters. Pp. 150. Descriptive data on Types SH and DH speed reducers of single helical gear type, D.D. 25-030. Pp. 8.

Forging Press. Chambersburg Engineering Co., Chambersburg, Pa. Bulletin 300, describing features of a high-speed steam-hydraulic forging press. Pp. 11.

Turbine Pumps. Roots - Connersville Blower Corp., of Connellsville, Ind. Bulletin 260-B 11B describes refinements in the company's Type "T" turbine pumps. Pp. 4.

Filters. Oliver United Filters, Inc., 33 West 42d St., New York City. Bulletin 210, describing the manufacturers' low-submergence filters. Pp. 4.

Variable Speed Control. Reeves Pulley Co., Columbus, Ind. Small booklet describing basic units of speed control and illustrating various industrial applications. Pp. 32.

Bronze Bearings. Randall Graphite Products Corp., 609-613 West Lake St., Chicago, Ill. Booklet with marginal thumb index, listing dimensions of standard bronze graphite bushings and sheave bearings. Pp. 24.

Equipment Catalog. K. C. Stanhope, Inc., 101 West 31st St., New York City. Catalog 37, listing new and used equipment and machinery for mining, construction, and industrial purposes. Pp. 32.

Diesel Engines. Nordberg Mfg. Co., Milwaukee, Wis. Bulletin 51-A illustrates and describes that company's four-cycle engine. Bulletin 75 describes the two-cycle type, air and mechanical injection. Pp. 20.

Jackbits. Ingersoll-Rand Co., 11 Broadway, New York City. A booklet, No. 2304, covering characteristics and uses of jackbits for rock drilling. Dimensions and prices of jackbits and jackrods are included. Pp. 27.

Woven Wire Screens. W. S. Tyler Co., 3605 Superior Ave., Cleveland, Ohio. An indexed booklet containing revised price list and specification tables of wire screens. Pp. 64.

Riveting Aluminum. Aluminum Company of America, Pittsburgh, Pa. Booklet containing numerous tables of data on aluminum rivets and description of driving methods of riveted joints. Pp. 34.

Chimney Reconditioning. Weber Chimney Co., 1452 McCormick Bldg., Chicago, Ill. Illustrated folder showing methods of repairing tall chimneys. Pp. 6.

Crushers. Traylor Engineering & Manufacturing Co., Allentown, Pa. Bulletin 3012 fully describes sizes of Type TY reduction crushers. Pp. 17.

Portable Threading Machine. Beaver Pipe Tools, Inc., Warren, Ohio. Illustrated folder of portable unit for cutting and threading pipe and bolts. Pp. 8.

Multiple Hearth Furnaces. Nichols Engineering & Research Corp., New York City. Bulletin 206 describes application of Nichols Herreshoff Multiple Hearth Furnace and general description of its design and some applications in study. Pp. 24.

Ore-Dressing Notes. American Cyanamid Co., 30 Rockefeller Plaza, New York City. Issue No. 6 has 27 pages and discusses cyanidation of concentrates, and issue No. 7 treats of flotation reagents. Pp. 19.

Conveying Equipment for High Temperatures. Baldwin-Duckworth Chain Corp., Springfield, Mass. Bulletin entitled Dossier A-1 describes conveyor material for high-temperature work. Pp. 7. Bulletin 59 describes the manufacture's non-corrosive and heat-resistant chains. Pp. 7.

Pillow Blocks. Randall Graphite Products Corp., 609-613 West Lake St., Chicago, Ill. Small booklet containing specifications and installation data on six types of pillow blocks. Pp. 23.

Summary of the

MARKETS

BUYING of major non-ferrous metals during May was on a reduced scale, compared with the average of the first four months of the year, owing largely to some uncertainty over the price trend this summer. Actual consumption of metals, however, continued at a satisfactory rate, notwithstanding labor troubles in various industries and general political unrest. Prices for domestic copper, lead, and zinc did not move throughout the month. The London market was slightly easier on increased offerings of futures.

The *E.&M.J.* index of non-ferrous metal prices for May was 93.25 which compares with 98.62 in April and 103.78 in March. In May, 1936, the index stood at 72.51.

The feature in copper was the widespread concern about production outside of the United States. Copper executives met in London to further the plan for again restricting production. Smelter production of copper during April—domestic and foreign—by producers reporting to the Copper Institute was at the annual rate of 2,588,880 short tons, an all-time high. Some producers, it is understood, have questioned the wisdom of curtailing output with the price abroad holding at 14c. and higher. The so-called marginal producers, they contend, will be heard from in a larger way at that level and aluminum will crowd copper as never before in important consuming centers. The United States import tax on copper is expected in most quarters to be continued for a period of two years.

There was more buying interest in lead in the last month than in either copper or zinc. Domestic consumption of lead appears to be established at around 50,000 tons a month.

Zinc remains scarce on spot, but larger supplies are expected in another month or two, which tends to ease the tension among consumers.

UNITED STATES MARKET

1937	Electrolytic Copper Domestic (a)	Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
May						
1	13.775	13.600	55.500	6.00	5.85	6.75
3	13.775	13.875	57.125	6.00	5.85	6.75
4	13.775	14.000	56.000	6.00	5.85	6.75
5	13.775	13.900	55.625	6.00	5.85	6.75
6	13.775	13.950	54.900	6.00	5.85	6.75
7	13.775	13.900	55.325	6.00	5.85	6.75
8	13.775	13.975	55.450	6.00	5.85	6.75
10	13.775	14.000	55.375	6.00	5.85	6.75
11	13.775	13.900	54.700	6.00	5.85	6.75
12	13.775	13.900	54.700	6.00	5.85	6.75
13	13.775	13.900	54.700	6.00	5.85	6.75
14	13.775	13.800	54.625	6.00	5.85	6.75
15	13.775	13.825	55.000	6.00	5.85	6.75
17	13.775	13.850	55.000	6.00	5.85	6.75
18	13.775	14.050	55.250	6.00	5.85	6.75
19	13.775	14.275	56.375	6.00	5.85	6.75
20	13.775	14.200	56.125	6.00	5.85	6.75
21	13.775	14.150	56.575	6.00	5.85	6.75
22	13.775	14.050	56.375	6.00	5.85	6.75
24	13.775	14.150	56.800	6.00	5.85	6.75
25	13.775	14.325	56.750	6.00	5.85	6.75
26	13 775	14.275	56.000	6.00	5.85	6.75
27	13.775	14.175	55.750	6.00	5.85	6.75
28	13.775	14.100	55.625	6.00	5.85	6.75
29	13.775	14.100	55.625	6.00	5.85	6.75
31	Holiday	13.750	Holiday	Holiday	Holiday	Holiday
For month average	13.775	13.999	55.651	6.00	5.85	6.75
AVERAGES FOR WEEK						
May						
5	13.775	13.742	55.750	6.00	5.85	6.75
12	13.775	13.938	55.075	6.00	5.85	6.75
19	13.775	13.950	55.158	6.00	5.85	6.75
26	13.775	14.192	56.438	6.00	5.85	6.75
CALENDAR WEEK AVERAGES						
May						
1	14.025	13.629	55.729	6.00	5.85	6.75
8	13.775	13.933	55.738	6.00	5.85	6.75
15	13.775	13.888	54.850	6.00	5.85	6.75
22	13.775	14.096	55.950	6.00	5.85	6.75
29	13.775	14.188	56.092	6.00	5.85	6.75

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

1937	Sterling Exchange "Checks"	Sterling Exchange "90-day demand"	Silver (c) New York	Silver London	Gold London	Gold (d) United States
May						
1	4.93750	4.92250	(e)	20.3750	140s 8 d	$35.00
3	4.93500	4.92000	45.000	20.3125	140s 10 d	35.00
4	4.93375	4.92000	45.000	20.3125	140s 8½d	35.00
5	4.93250	4.91875	45.125	20.4375	140s 9½d	35.00
6	4.93625	4.92125	45.125	20.4375	140s 8½d	35.00
7	4.93375	4.91875	45.000	20.3750	140s 8 d	35.00
8	4.93500	4.92125	(e)	20.3750	140s 8½d	35.00
10	4.93500	4.92000	45.000	20.3750	140s 9 d	35.00
11	4.94000	4.92625	45.000	20.3750	140s 7 d	35.00
12	4.94125	4.92750	45.000	Holiday	Holiday	35.00
13	4.94125	4.92625	45.000	20.3750	140s 5½d	35.00
14	4.93625	4.92125	45.250	20.4375	140s 8 d	35.00
15	4.94125	4.92625	(e)	20.3750	140s 6½d	35.00
17	4.94375	4.92875	45.250	Holiday	Holiday	35.00
18	4.94125	4.92500	45.125	20.3750	140s 5½d	35.00
19	4.93875	4.92250	45.000	20.3750	140s 5½d	35.00
20	4.94125	4.92625	44.875	20.3125	140s 6½d	35.00
21	4.94000	4.92500	44.875	20.3750	140s 6 d	35.00
22	4.94000	4.92500	(e)	20.3750	140s 6 d	35.00
24	4.94250	4.92750	44.875	20.2500	140s 6 d	35.00
25	4.94000	4.92500	45.000	20.3750	140s 5½d	35.00
26	4.94000	4.92500	45.000	20.2500	140s 7 d	35.00
27	4.94000	4.92500	45.000	20.3125	140s 7 d	35.00
28	4.93875	4.92375	45.000	20.2500	140s 6 d	35.00
29	4.93375	4.91875	(e)	20.2500	140s 7½d	35.00
31	Holiday	Holiday	Holiday	20.2500	140s 9½d	Holiday
Av. for month	4.93835	.....	45.025	20.346	.....	35.00
AVERAGES FOR WEEK						
May						
5	4.93771	.....	45.075	.....	.....	.....
12	4.93688	.....	45.025	.....	.....	.....
19	4.94042	.....	45.125	.....	.....	.....
26	4.94063	.....	44.925	.....	.....	.....

Calendar week averages: New York Silver, May 1st, 45.100; 8th, 45.050; 15th, 45.050; 22nd, 45.025; 29th, 44.975.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and interest charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57. Handy & Harman's quotation for domestic silver, .999 fine, was 77c. per ounce throughout May.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1937	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Standard					
May	Spot	3M	Bid	Spot	3M	Spot	3M	Spot	3M
3	59.2500	57.5000	63.0000	255.0000	252.0000	24.6250	24.5000	23.8125	24.1250
4	60.2500	57.8750	63.5000	252.0000	249.0000	24.5000	24.4375	23.8750	24.1250
5	59.5000	56.6250	63.0000	249.0000	247.0000	23.8750	23.8125	23.0000	23.2500
6	60.0000	56.8750	63.0000	249.5000	248.0000	24.0625	24.0000	23.1250	23.3750
7	60.1250	56.8750	63.0000	249.0000	247.0000	24.0625	24.0000	23.1875	23.5000
10	61.7500	58.3750	64.0000	251.7500	250.2500	24.5000	24.3750	23.5625	23.8750
11	60.7500	57.3750	63.5000	247.7500	246.0000	23.5000	23.3750	22.6875	23.0000
12				Holiday					
13	62.0000	58.0000	64.0000	250.0000	247.2500	23.6250	23.5000	22.5000	22.8750
14	61.7500	57.0000	63.0000	249.0000	242.7500	22.9375	22.7500	21.8750	22.2500
17				Holiday					
18	62.7500	58.2500	64.0000	249.5000	245.2500	22.6250	22.5000	22.1875	22.5000
19	63.7500	59.3750	64.0000	254.0000	250.2500	23.5625	23.4375	22.9375	23.2500
20	62.1250	58.5000	64.0000	250.2500	248.3750	24.2500	24.1250	23.1250	23.4375
21	61.2500	59.2500	64.0000	252.7500	250.7500	24.6875	24.5625	23.6250	23.8750
24	62.0000	59.8750	64.5000	253.5000	252.7500	24.6875	24.6250	24.1875	24.4375
25	63.2500	60.9375	65.0000	253.0000	252.0000	24.9375	24.8125	23.9375	24.1875
26	61.5000	59.8125	64.5000	252.0000	250.7500	24.3750	24.2500	23.3750	23.6250
27	61.0000	58.8750	64.0000	249.7500	248.7500	23.7500	23.6875	22.8750	23.1250
28	60.2500	58.2500	64.0000	248.7500	247.8750	24.0000	23.8750	22.7500	23.0000
31	58.0000	57.1875	62.0000	245.7500	244.7500	23.4375	23.3125	22.1250	22.1250
Av. for month	61.118	.....	63.684	250.645	.....	24.0000	23.891	23.092	23.365

CURRENT PRICES—MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(June 1, 1937)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb.	20c.
Antimony, domestic, spot, lb.	15.000c.
Bismuth, ton lots, lb.	$1.00
Cadmium, lb.	90c @$1.20
Calcium, lb., ton lots 98 @ 99 per cent	75c.
Chromium, 97 per cent grade, lb.	85c.
Nickel, electrolytic cathodes, lb.	35c.
Magnesium, 99.8 per cent, carloads, lb.	30c.
Palladium, troy oz.	$24.00
Platinum, (Official quotation) troy oz.	$54.00
Quicksilver, flask of 76 lb., 100 flasks or more	$96.00@$98.00
Radium, mg. radium content	$40.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent, spot, lb.	16.50c.
Tellurium, lb.	$1.75@$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45 @ 47 per cent, c.i.f. Atl. ports, long ton	$21.00@$21.50
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent Joplin, Mo., ton	$70 31
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52 @ 55 per cent	42c.
49 @ 51 per cent	40c.
44 @ 47 per cent	36c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$21.50
Domestic Scheelite	$21.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc, Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$45.00

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb.	3c
Cobalt Oxide, 70 @ 71 per cent, lb.	$1.41@$1.51
Copper Sulphate, 100 lb.	$5.15
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.34
Sodium Sulphate, bulk, ton	$13.00@$15.00

ALLOYS

Beryllium Copper, Master alloy, 2.5 to 3 per cent Be, per lb. of contained Be.	$23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb.	10½c.
Ferromanganese, 78 @ 82 per cent, gross ton	$102.50
Ferromolybdenum, 50 @ 60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton.	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.80@$1.85

NON-METALLIC MINERALS

Asbestos, f.o.b. mines ton:	
Canadian (Quebec)	
Crude No. 1	$550@$600
Crude No. 2	$200@$225
Spinning fibers	$90@$170
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$47.50.....
Paper stock	$35 @.....
Cement stock	$23 @.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$7.00
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6@ $7.50
Domestic, abrasive, 70 @ 84 per cent	$12.50@$15.00
Dalmatian, 50 @ 55 per cent	(a)$5.50@$7.00
French, 56 @ 59 per cent	(a)$6.50@ 7.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.50@$8.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$20.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$25.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	15@30c.
2 x 2 in.	30@50c.
3 x 3 in.	75@$1.00
3 x 4 in.	$1.00@$1.25
4 x 6 in.	$2.00@$2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$15.00@.....
200 mesh, cream colored	$25.00@.....

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$37.00
Structural shapes, 100 lb.	$2.25
Bars 100 lb.	$2.45

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1936	1937	1936	1937	1936	1937
January	47.250	44.913	20.250	20.734	496 115	490.670
February	44.750	44.750	19.796	20.083	499.908	489.307
March	44.750	45.130	19.663	20.677	496.952	488.412
April	44.892	45.460	20.245	20.740	494.139	491.524
May	44.869	45.025	20.248	20.346	496.850	493.835
June	44.750	.....	19.770	.....	501.817	.....
July	44.750	.....	19.590	.....	502.178	.....
August	44.750	.....	19.490	.....	502.519	.....
September	44.750	.....	19.579	.....	503.455	.....
October	44.750	.....	19.977	.....	489.755	.....
November	45.431	.....	21.050	.....	488.727	.....
December	45.352	.....	21.238	.....	490.670	.....
Year	45.087	.....	20.075	.....	496.924	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		(a) Electrolytic	
	1936	1937	1936	1937	1936	1937	1936	1937
January	9.025	12.415	8.358	12.112	34.706	51.497	38.788	56.497
February	9.025	13.427	8.566	13.828	35.313	59.225	39.463	64.013
March	9.025	15 775	8.708	16.590	36.040	72.339	40.227	76.167
April	9.169	15.121	8.849	14.692	36.975	62.506	41.131	66.614
May	9.275	13.775	8.819	13.999	36.690	61.118	40.839	63.684
June	9.275	.....	8.790	.....	36.324	.....	40.357	.....
July	9.352	.....	8.993	.....	37.217	.....	41.228	.....
August	9.525	.....	9.297	.....	38.259	.....	42.375	.....
September	9.525	.....	9.523	.....	38.915	.....	43.267	.....
October	9.563	.....	9.669	.....	40.980	.....	45.295	.....
November	10.161	.....	10.349	.....	43.932	.....	48.467	.....
December	10.763	.....	10.835	.....	45.946	.....	50.364	.....
Year	9.474	.....	9.230	.....	38.441	.....	42.650	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1936	1937	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.500	6.000	4.350	5.850	15.397	15.494	27.272	27.150
February	4.515	6.239	4.365	6.089	16.022	16.141	28.319	28.328
March	4.600	7.190	4.450	7.040	16.608	16.767	33.027	32.979
April	4.600	6.175	4.450	6.025	16.097	16.234	26.014	25.878
May	4.600	6.000	4.450	5.850	15.530	15.601	24.000	23.891
June	4.600	.....	4.450	.....	15.170	15.259	.....	.....
July	4.600	.....	4.450	.....	15.856	15.954	.....	.....
August	4.600	.....	4.450	.....	16.772	16.859	.....	.....
September	4.600	.....	4.450	.....	18.009	17.974	.....	.....
October	4.631	.....	4.488	.....	18.446	18.375	.....	.....
November	5.114	.....	4.964	.....	21.723	21.693	.....	.....
December	5.554	.....	5.406	.....	25.560	25.503	.....	.....
Year	4.710	.....	4.560	.....	17.599	17.655	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton

TIN

	Straits, New York		Standard, Spot, London	
	1936	1937	1936	1937
January	47.234	50.925	209.731	229.350
February	47.962	52.010	207.081	233.750
March	48.037	63.043	213.080	282,988
April	46.963	59.172	209.313	267.136
May	46.352	55.651	202.429	250.645
June	42.204	.....	183.167	.....
July	43.021	.....	185.957	.....
August	42.579	.....	183.731	.....
September	44.754	.....	194.676	.....
October	44.975	.....	201.193	.....
November	51.392	.....	230.869	.....
December	51.823	.....	232.108	.....
Year	46.441	.....	204.445	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.848	5.847	14.488	14.719	21.153	21.281
February	4.859	6.465	15.125	15.391	25.122	25.322
March	4.900	7.381	15.283	16.190	33.188	33.405
April	4.900	7.010	15.181	15.334	26.216	26.344
May	4.900	6.750	14.536	14.777	23.092	23.365
June	4.880	.....	13.896	14.122	.....	.....
July	4.783	.....	13.579	13.826	.....	.....
August	4.800	.....	13.528	13.759	.....	.....
September	4.850	.....	13.906	14.159	.....	.....
October	4.850	.....	14.554	14.835	.....	.....
November	4.974	.....	16.301	16.554	.....	.....
December	5.273	.....	17.957	18.145	.....	.....
Year	4.901	.....	14.920	15.151	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1936	1937	1936	1937
January	105.000	90.000	20.000	19.500
February	105.000	90.000	20.000	19.500
March	105.000	101.667	20.000	20.000
April	105.000	105.000	20.000	20.000
May	105.000	105.000	20.000	20.000
June	105.000	.....	20.000	.....
July	93.462	.....	20.000	.....
August	90.000	.....	20.000	.....
September	90.000	.....	20.000	.....
October	90.000	.....	20.000	.....
November	90.000	.....	20.000	.....
December	90.000	.....	20.000	.....
Year	97.789	.....	20.000	.....

Aluminum in cents per pound, 99 per cent grade. Cadmium, cents per pound.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1936	1937	1936	1937	1936	1937
January	12.736	14.130	76.769	90.250	36 885	50.404
February	12.967	14.563	77.000	91.000	35.000	64.360
March	13.072	16.375	77.000	91.778	34.115	58.000
April	12.673	16.043	76.731	92.000	32.846	58.000
May	12.410	14.830	74.940	95.520	32.000	54.800
June	11.707	.....	74.192	.....	36.346	.....
July	11.245	.....	73.423	.....	39.308	.....
August	11.125	.....	73.923	.....	49.577	.....
September	11.740	.....	85.280	.....	68.960	.....
October	12.058	.....	89.240	.....	54.074	.....
November	12.233	.....	90.250	.....	48.000	.....
December	12.918	.....	90.250	.....	48.000	.....
Year	12.240	.....	79.917	.....	42.926	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quick silver in dollars per flask of 76 lbs. (c) Platinum in dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1936	1937	1936	1937	1936	1937
January	20.00	21.50	19.00	20.50	19.50	21.00
February	20.00	21.50	19.00	20.50	19.50	21.00
March	20.00	24.20	19.00	23.20	19.50	23.70
April	20.00	24.50	19.00	23.50	19.50	24.00
May	20.00	24.50	19.00	23.50	19.50	24.00
June	20.00	.....	19 00	.....	19.50	.....
July	20.00	.....	19.00	.....	19.50	.....
August	20.00	.....	19.00	.....	19.50	.....
September	20.00	.....	19.00	.....	19.50	.....
October	20.00	.....	19.00	.....	19.50	....
November	20.23	.....	19.23	.....	19.73	....
December	21.00	.....	20.00	.....	20.50	....
Year	20.103	.....	19.103	.....	19.603	. ..

Iron in dollars per long ton. F. o. b. Mahoning and Shenango Valley furnaces